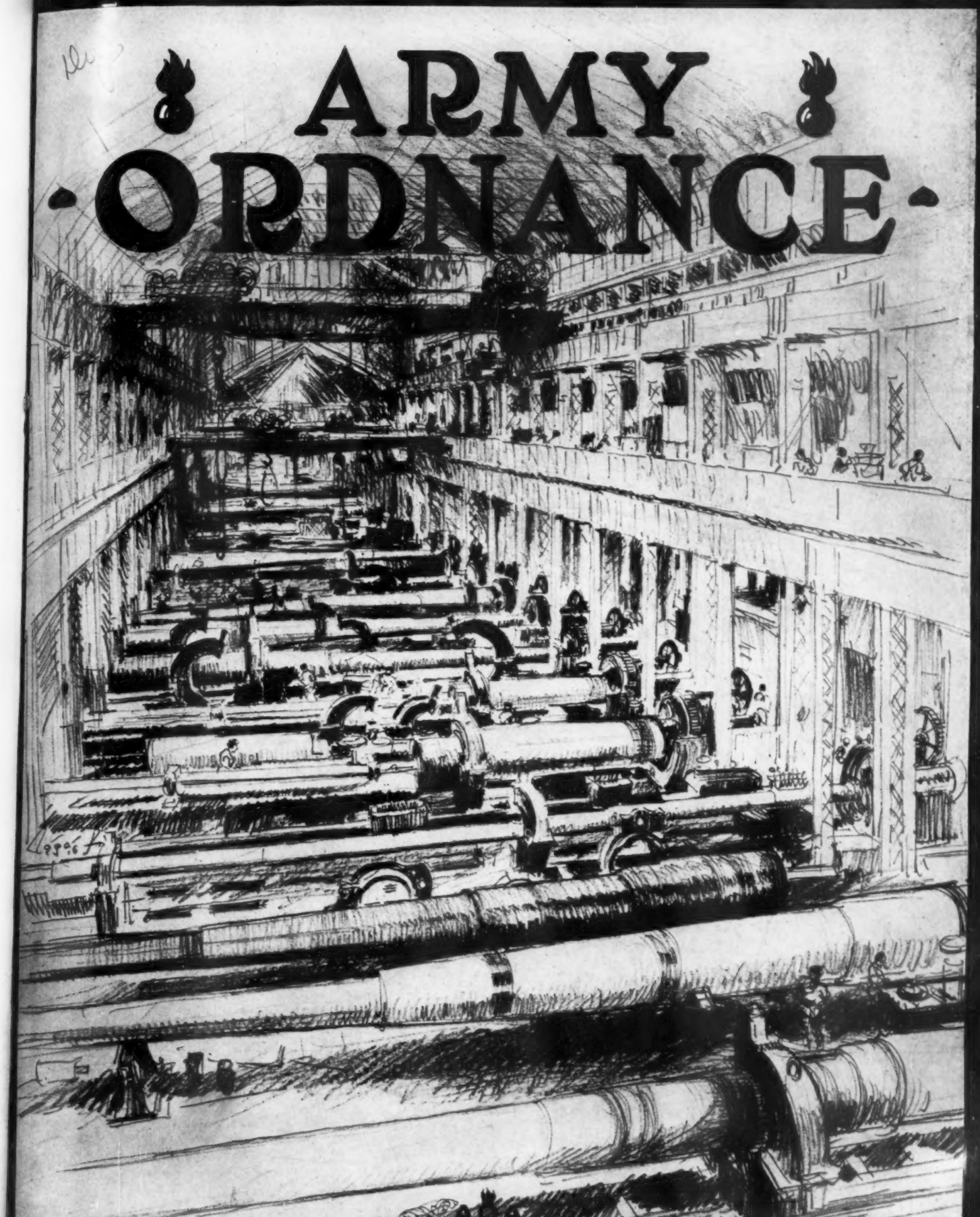
ARMY ORDNANCE



THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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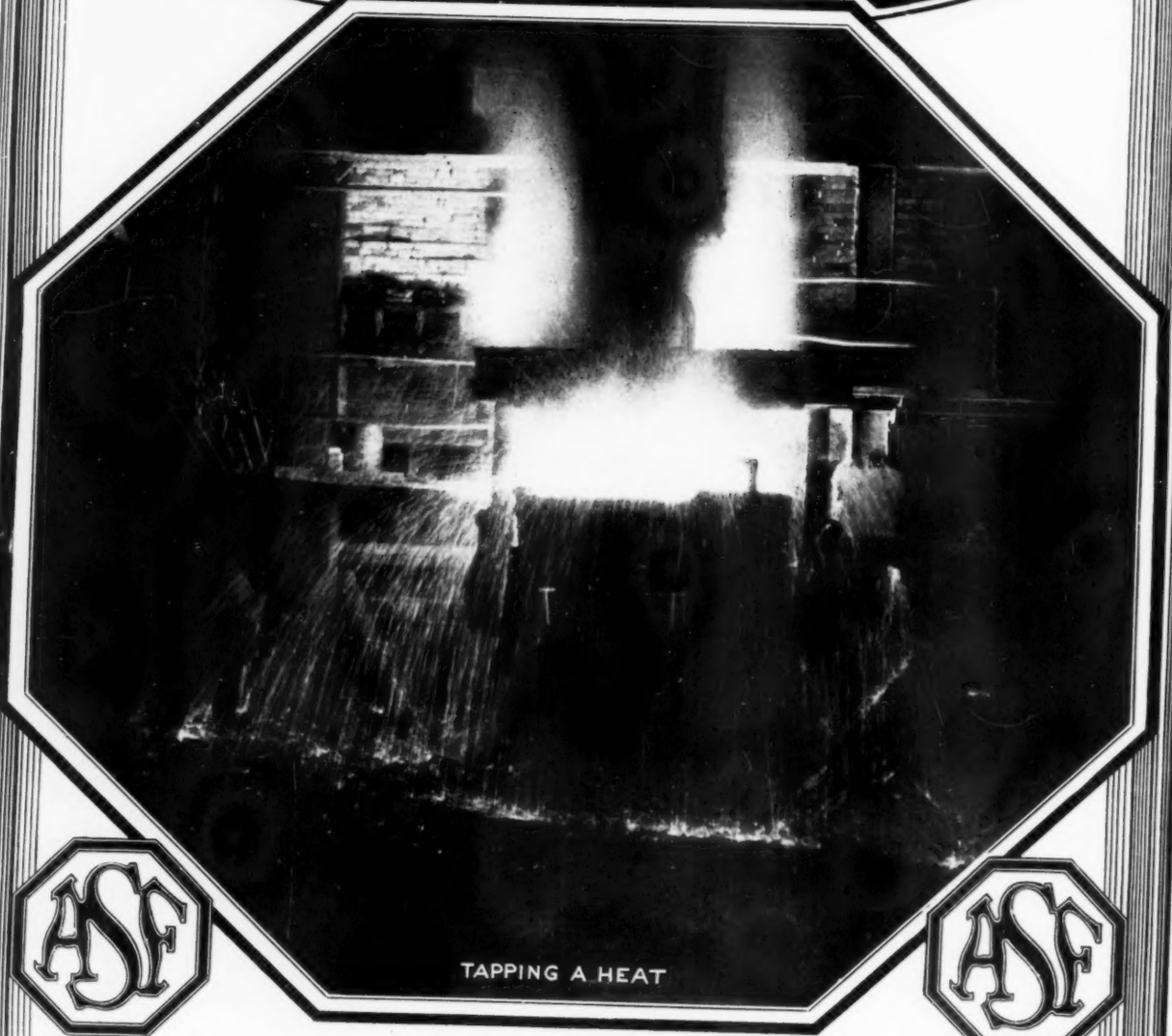

TAPPING A HEAT

STEEL CASTINGS OF EVERY DESCRIPTION
FOR
ARMY AND NAVY REQUIREMENTS

ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

Published by the Army Ordnance Association, The Mills Building, Washington, D. C. L. A. Codd, Editor.

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"The industrial war plan must conform to the living body of industry—to its customs, practices, organization and character. No human mind can grasp every detail. It can only be developed by years of labor and research. Occupying the space between the continuously changing body of industry and the intermittently changing war plan, it must slowly shape itself to each."

—*Patrick J. Hurley, Secretary of War.*

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THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our Nation's strongest guarantee of peace.

THE Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.

THE Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the Nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

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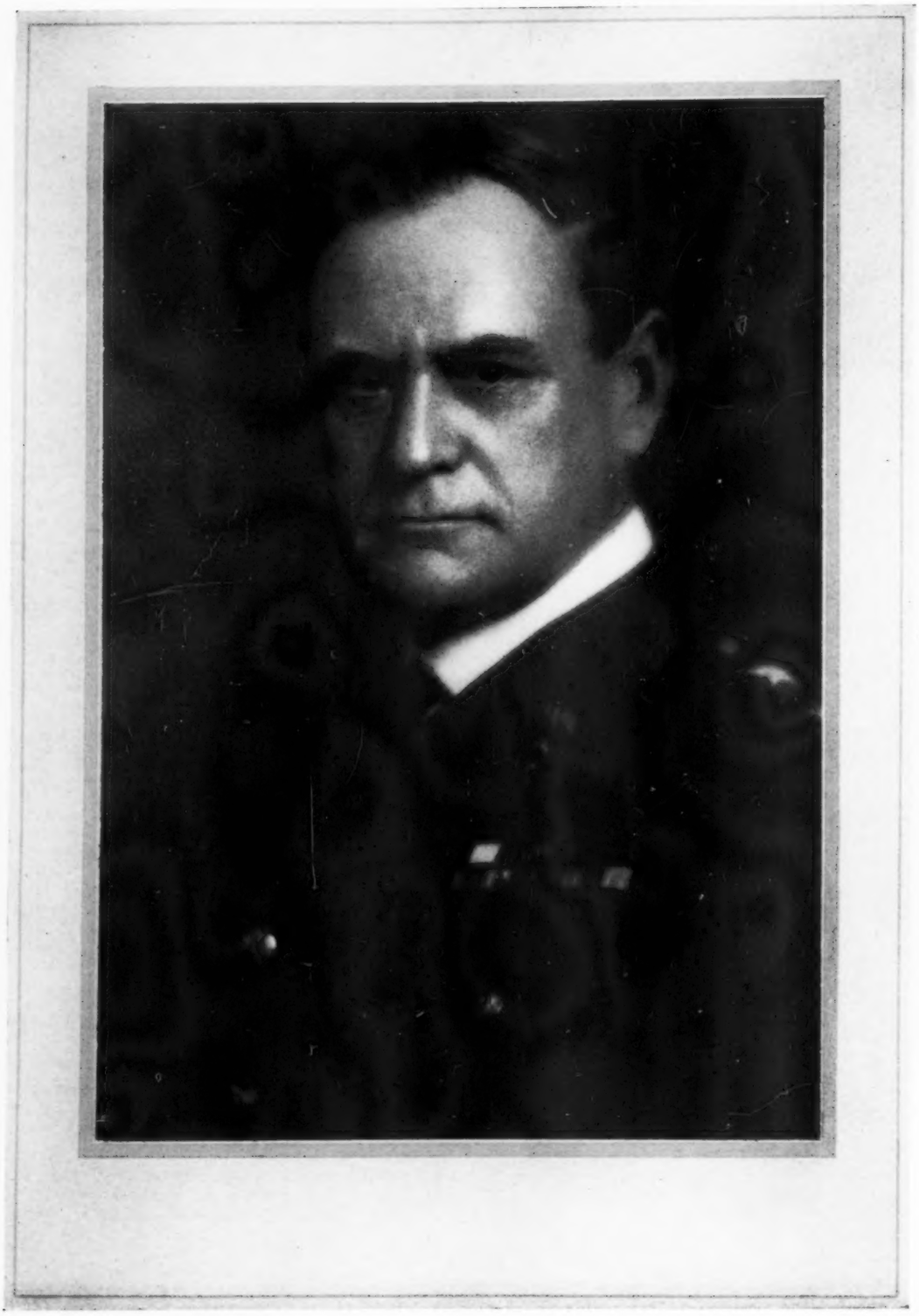

Maj. Gen. C. C. Williams, U. S. A., Ret.

Whose Outstanding Service to the Nation, American Industry and the Army Terminated April 1, 1930, Upon His Retirement After Twelve Years As Chief of Ordnance and Thirty-nine Years of Active Military Service.

The Retirement of General Williams

IT is difficult to write of the retirement of Maj. Gen. C. C. Williams who, on April 1, will relinquish command of the Ordnance Department of the Army and retire from active military duty after 39 years of service. His tenure of that important office, begun in the critical war days of 1918 and so successfully conducted without interruption since, was of such an outstanding character that some word of tribute and appreciation is fitting. I undertake the duty with a sense of personal feeling which, I am certain, is shared by his many friends and admirers.

Having been appointed Acting Chief of Ordnance in April, 1918, and Chief in July of the same year, General Williams filled his important office with distinction for more than 12 years, a term exceeded in length of service in that office only by Col. George Bumford (1832-1848), Brig. Gen. S. V. Benét (1874-1891) and Maj. Gen. William Crozier (1903-1918). Since 1815, when Col. Decius Wadsworth became the first Chief of Ordnance in our Army, there have been only twelve incumbents during a period of one hundred and fifteen years.

IT is not alone of General Williams length of service of which I write, although had those years been of even inconsequential import, the term in itself would have been significant. But they were the most momentous years not only of our own history but possibly of the entire world. They brought the greatest of all wars and the greatest of all developments affecting the whole field of combat and practically the entire technique of the design and manufacture of munitions. In my contact with military affairs during the war and since, I have heard from all quarters the highest praise of General Williams in his conduct of what I consider one of the most important of all the services and branches of the Army. Thus it is that I desire to pay public tribute to the man and his work. I am confident that I voice the sentiment of the thousands who served with General Williams during the World War in the War and Ordnance Departments, here and overseas, and in industrial life.

Smokeless powder and metallurgy were the fields in which General Williams had played conspicuous part as an officer in the lower grades. In 1898 he joined the famous Astor Battery and saw service as an officer of the Field Artillery in the Philippines. In 1916 he was Department Ordnance Officer at the time of Pershing's Punitive Expedition into Mexico. He was a member of that first small contingent that sailed with Pershing on the S. S. Baltic for France, and served as Chief Ordnance Officer of the A. E. F. from June, 1917, to April, 1918. For his World War service he was awarded the Distinguished Service Medal with this citation: "For exceptionally meritorious and distinguished services. An officer of high professional attainments, who rendered particularly valuable services in the organization of the Ordnance Department of the American Expeditionary Forces and exhibited unusual ability in arranging for the procurement of ordnance material and ammunition for the American Army in Europe." His service was also recognized by three foreign governments, having been honored with Officer and later Commander of the Legion of Honor (French); Companion of St. Michael and St. George (British); Commander, Order Polonia Restitua (Polish).

I FIND every attribute of the real officer, administrator and executive in the career of General Williams. First among these should be placed his broad viewpoint—a characteristic not always present in our best executives of civil and military calling. Definite and clear cut in his objectives, nevertheless compromise found place in his decisions. Such a makeup has tremendous directive force particularly in the complicated technical and scientific field of Ordnance. I should call it General Williams' business outlook. His is not the bureaucratic mind or temperament. Indeed the much discussed slogan "putting business into Government" has no truer personification than General Williams. Coincident with this viewpoint was his innate ability to select men. I doubt if any branch of our great World War machinery excelled in quality the men selected by General Williams to carry on with him the work of his department. This, coupled with his organizing ability, placed the work of the Department on a plane of such efficient degree that it surmounted insuperable difficulties and established a record for all time in the speed and efficiency with which its problems were met and its programs fulfilled.

In the sphere of post-war activities General Williams rose to even greater heights. It is one thing to accomplish when the stimulus of actual war is present and quite another when in peace our traditional disinterestedness in weapons is almost universal. Thanks to him, peace brought opportunity for further development which under his leadership was revolutionary. He made his department, I may say without exaggeration, a byword for high morale, efficient operation and splendid performance. The best of his accomplishments in this period, in my judgment, was the zeal with which he nurtured the infant prodigy, Industrial Preparedness. The World War proved modern munitionment to be essentially an industrial problem. No one accepted that conclusion more completely than General Williams and no one endeavored to apply it with more understanding. After 11 years of trial and operation, this new theory is definitely a part of our national defense plans coequal in acknowledged importance with any and all other elements of our system. General Williams with his clear perception of fundamentals gave this newcomer just the proper degree of impetus necessary to assure that it did not falter or go astray.

THERE were other matters of vital importance to which his energy was applied with equal vigor. I can refer only to the principal developments of his tenure. Taking the major classifications of ordnance, we find practically every item of the Caliber Board recommendations for rearmament successfully developed. That board, it will be remembered, specified the desired characteristics and the types of our new weapons in the light of World War experience. Our new light and heavy artillery represents exceptional advancement. Our coast defense armament likewise is a great improvement over the old. Our small arms have developed to the point of a new semi-automatic rifle soon to be adopted. Our ammunition of all classes as to powder, fuzes and all other components has progressed in design and serviceability equally with the weapons in which it is used. Our developments of bombs, from practically nothing of World War days to the present, have advanced to the point where for demolition and fragmentation effect they meet the requirements of modern tactics. The airplane in its evolution to present efficiency has had flying in unison with it a bomb program without which the efficiency of our air force would be greatly lessened if not entirely inadequate. Simultaneously we have seen the striking power of the plane curbed by our new antiaircraft guns. Certainly no period in the entire history of the development of weapons has seen the advancement of any instrument of defense comparable to that of antiaircraft during the past twelve years.

Our tanks meet the exacting demands of tactical use and commercial production. While there has been some difference of opinion on the exact types of tanks, it must always be said that General Williams viewed the problem in a spirit of openmindedness and cooperation. Our armament has been designed with the one objective: satisfaction to the using services. His attitude always was "Can their expressed needs be met"—not should they be. This was the Williams' motto, and to it should be laid the cause of the splendid esprit between all services of the Army and the Department. To the man himself, his personality and his ability, we must accredit the unusual morale of his organization.

NOW, I do not mean to imply that to General Williams should go all the praise for the developments to which I have referred. The head of so large an organization must depend on the qualifications of the engineers and executives under him. General Williams has always impressed me as having that innate administrative qualification, so necessary to success, of selecting the right man for the job and then allowing him full rein. At the same time there was scarcely a detail of operation with which he was not in close touch. The men under him, of course, were the active agents in the work but he was the guiding mind and inspiration.

The War Department and American industry have lost a leader. I cannot speak too highly of the man and his work. He is justly entitled to the relaxation his retirement will bring. Distinguished in his chosen field, he relinquishes a command he has filled with phenomenal skill. I speak for the Army Ordnance Association in congratulating him on his great success. His work is a testimonial to a man of outstanding ability, of real accomplishment, of high but always practical ideals.

Bernard Carroll

President, The Army Ordnance Association.

ARMY ORDNANCE

VOL. X MARCH-APRIL, 1930 No. 59

Welded Weapons

New Processes Applied to the Manufacture of Ordnance

By J. B. Rose*

HOWEVER much one may investigate the physical characteristics of welded joints, such as porosity, grain structure, strength or resistance to fatigue, and whatever conclusions one may draw from these as to the possibilities of welding, it is only by fabrication of actual parts and test in service that final decision can be reached as to how far one can go in the application of welding.

Fig. 1. Welded Trail for 105-mm. Howitzer Carriage.

It was for this reason the Watertown Arsenal immediately upon installing its welding equipment during March, 1929, sought to incorporate welded components in various types of ordnance as quickly as possible and began, with the approval of the Chief of Ordnance, new designs of artillery carriages in which full advantage could be taken of the process. The illustrations to be presented will show more clearly than discussion the variety of applications which have been possible in a rather brief period.

The design section of the arsenal first required reliable data on physical characteristics that might be expected in work as executed at the arsenal, and it was necessary therefore to carry on from the beginning a quite extensive program of experimental welding to determine the quality and strength of typical welds, to develop the technique of the welding squad, and to determine the choice and use of materials. In this work, the assistance of the laboratory personnel and equipment has been indispensible. This experimental work has involved the investigation of several hundred welds made with numerous types of electrode wire to select those which gave the best results with different kinds of plate. At the same time such welds were given a variety of anneals to determine which left the product in the best condition for service. Several hundred of these specimen welds were examined under the X-ray and the grain structure examined by etching, by microphotographs, and tests for hardness in the several zones of the weld and affected plate.

In this way the quality of work to be expected and characteristics of welds under tension, fatigue and impact were rather thoroughly studied although much remains to be done. At the same time training of personnel has been continuous, and no welder has been allowed on production until thorough examination of his work showed he could maintain the high quality demanded. As all production work has been X-rayed, it is not possible for a welder to slight the quality of his work, since detection is certain.

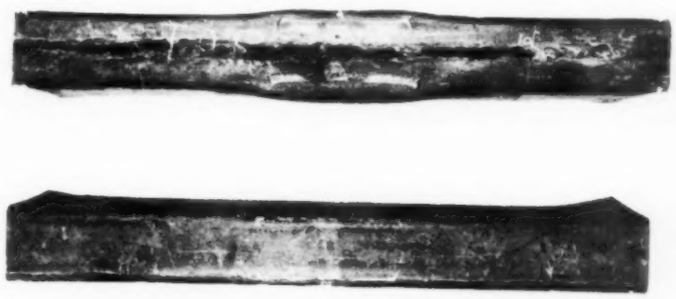

Fig. 2. Experimental Welded Section of Gun Carriage Trail.

Approximately one hundred fabricated parts, each of different design have been made and examined in this way, and it has been very gratifying to find in no case among several hundred films a defect in welding which would have raised a question as to the actual serviceability of the part and only a very small percentage of the films revealed defects which were even of negligible importance. As a spur to good work correction of some minor defects was required, and the feasibility of such correction of work may be noted as one of the advantages of the process.

Shop and service test of major welded components also have now been completed, and it has been concluded that it is entirely possible to maintain in fabrication of ordnance by welding a quality of work which will remove entirely any apprehension that parts designed with a suitable factor of safety may fail in service, and for reasons which will appear, it is felt lower factors of safety can be used generally with equal security than for castings.

Illustration of the application of welding to a number of ordnance structures will, it is believed, be of more interest to the readers of ARMY ORDNANCE than a discussion of the technical aspects of the art, and will show far more clearly

*Commanding Officer, Picatinny Arsenal, Dover, N. J. Formerly in charge of shops and laboratory, Watertown Arsenal, Watertown, Mass. Major, Ordnance Department, U. S. Army.

the almost unlimited possibilities of this process.

It may be stated here that it has been by no means necessary to seek opportunities to fabricate in this way — rather it has been impossible to change over designs and take full advantage of the cases where fabrication was obviously easy and desirable, as rapidly as these arose.

Fig. 3. Trails for 75-mm. Gun Carriage, T2.

Fig. 1 shows one of the first pieces of work completed. This part is one of two trails for a 105-mm. howitzer carriage made by welding along the four corners. There was some difference of opinion as to whether the trail should be made of four pieces so welded, or two formed U sections joined by welding along the middle line of the top and bottom. Experimental sections 7 by 3.5 inches of structural nickel steel as shown in Fig. 2 therefore were made. These were each placed on supports 29 inches apart and loaded at the center. The lower beam, welded at the corners, took a permanent set at load of 50,000 lbs. and the upper at 40,000 lbs. The lower beam failed, but not completely at 78,870 lbs., and the upper beam failed as shown rather seriously at 75,400 lbs. It will be noted failure was due primarily to a rolling in of the rounded corners which led to rupture of the weld. It may be concluded that failure in a trail so made will be due to a low section modulus of cross section rather than to local failure in the weld.

Fig. 4. Frame for Centrifugal Casting Machine.

In Fig. 3 are shown three trails recently completed for the 75-mm. gun carriage T2. These are of nickel steel plate, the trail connections being fabricated separately and then welded to the box sections. This welding was done under the automatic feed.

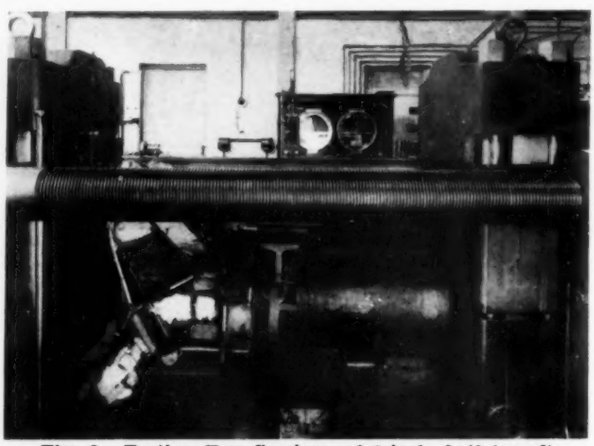

Fig. 6. Testing Top Carriage of 3-inch Antiaircraft Gun Mount.

Manufacture of a machine for making centrifugal castings called for a heavy frame similar to one previously made of east iron for a smaller machine. The cost of large patterns and core boxes was a large factor in the total cost, while the possibility of loss of the first casting would no doubt influence bidders for the casting. Therefore the frame was fabricated from 2-inch and 1-inch plate as shown in Fig. 4. Plate can be bought for about 2.5 cents a pound, while an iron casting would run to 6 cents and possibly 10 in a difficult shape of this kind. No conclusive comparison of total cost can be made as such comparison will vary according to local shop conditions and circumstances under which material is made or procured. In this case, it is estimated a distinct saving was affected.

Fig. 5. Top Carriage for 3-inch Antiaircraft Gun Mount.

Fig. 5 shows the top carriage of a 3-inch antiaircraft gun mount made from .25-inch structural nickel steel. In previous manufacture, it was necessary to reject five out of six castings delivered due to shrinkage cracks and low physicals, and it understood other rejections were necessary at the foundry. The welded part after assembly with the tube used as a pintle weighed 580 lbs. which was 418 lbs. less than the casting. This illustrates the reduction in weight which follows from use of material much stronger than can be obtained in castings, and at the same time more reliable since uniformity can be counted on. This com-

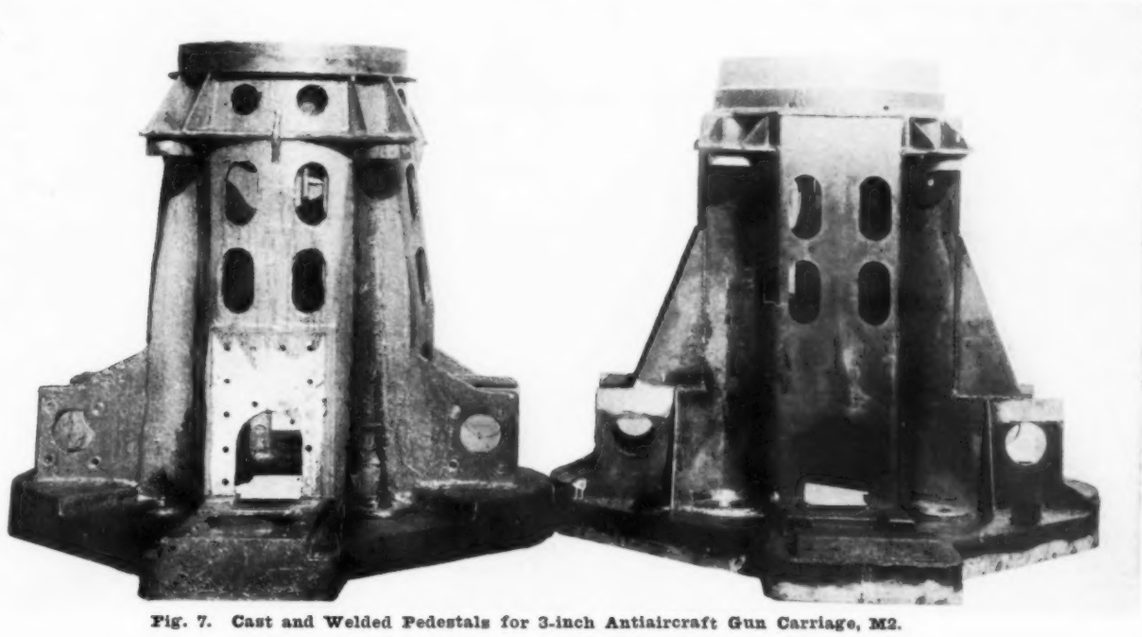

Fig. 7. Cast and Welded Pedestals for 3-inch Antiaircraft Gun Carriage, M2.

pleted part was assembled in a supporting cylinder to simulate service mounting and tested by applying a load of 40,000 lbs. at the trunnions, this being three times the firing load and producing a stress at critical sections equal to the calculated elastic strength. No permanent set could be detected.

The method of this test is shown in Fig. 6, the piece shown being the first one of these top carriages which in this case was made of .50-inch carbon steel plate. To reduce weight the .25 nickel steel plate was subsequently used.

In Fig. 7 is seen a comparative view of a pedestal casting for the 3-inch antiaircraft mount, and the replacing welded pedestal. This latter weighed 823 lbs. against 1,115 lbs. for the casting. It is well to note here that this similarity in appearance between cast and welded parts is quite usual where redesign for welding has been made. This merely indicates that, when necessary, such substitution in existing designs is not difficult, but in new designs based on welding this similarity may disappear largely.

This pedestal was assembled in a carriage and the whole tested under a load of 35,000 lbs. at the trunnions. It appeared that this load might have been easily increased, but it was feared other parts of the mount more severely stressed might be injured.

Fig. 8 shows the pedestal part for the 75-mm. gun carriage T3 made from tubing and .25-inch nickel plate. The top carriage for this mount is shown in Fig. 9, and the bogie box, or part which connects the pedestal and trails to the axle, in Figure 10. It was necessary to manufacture this carriage in four months after drawings were completed, and time would not have been available to make patterns and secure castings had these been required. Manufacture of the design was started in November, and at this date (January 15, 1930) the carriage is being assembled.

THIS time element in manufacture is another important factor in which welded construction plays a decisive part. Plate can be procured quickly, if not carried in stock, and work on those parts which are usually the last to obtain and most costly to machine, started at once. In

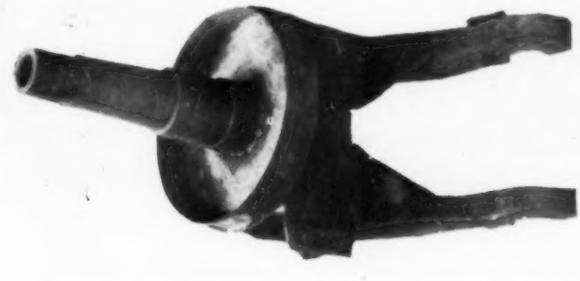

Fig. 9. Top Carriage for 75-mm. Gun Carriage, T3.

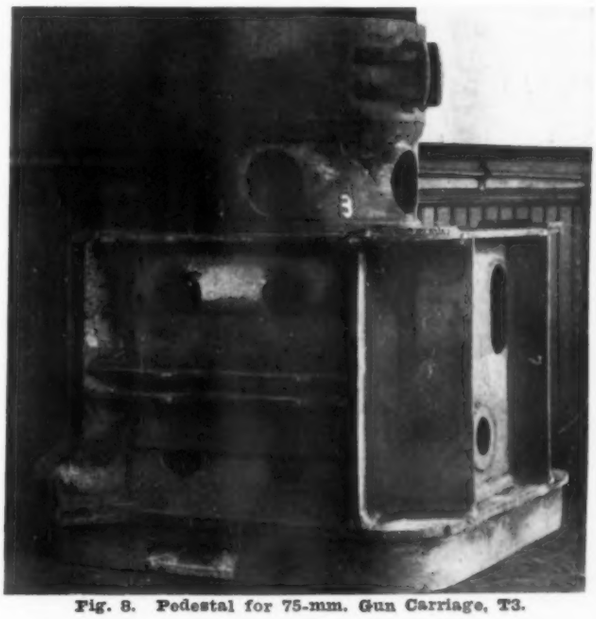

Fig. 8. Pedestal for 75-mm. Gun Carriage, T3.

addition, there is no measurable loss in manufacture from defects in material, nor loss of time in replacement. In construction of this kind, it may be claimed that an arsenal, without difficulty, may begin delivery of carriages within six months or less after receipt of drawings while in the past about twice this time has been necessary.

Fig. 10. Bogie Box for 75-mm. Gun Carriage, T3.

In this particular case, the weight element was also of great importance and while no castings have been made of the same design experience has shown that castings weigh from 30 to 50 percent. more than the same fabricated parts.

The top carriage and pedestal for the 75-mm. gun carriage T2 are shown in Figs. 11 and 12. These parts are built with carbon steel plate .50-inch thick or greater. The remarks on the preceding carriage apply in general to this also.

Top and bottom sleighs and cradle for the pack howitzer carriage are shown in Fig. 13. These parts were made to replace castings and have been sent to the Rock Island

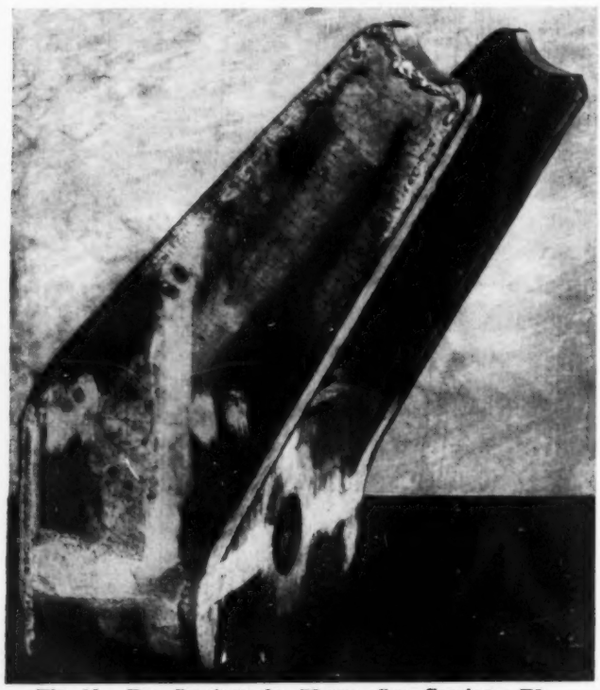

Fig. 11. Top Carriage for 75-mm. Gun Carriage, T3.

Arsenal for machining and assembly in a carriage. It is understood sound castings for these parts have been hard to procure. While a certain weight is necessary in the parts there is no doubt a saving could be effected if desired.

Fig. 14 shows one of three types of transoms used in the truck bogies of the 3-inch antiaircraft mobile carriages. Delivery of these castings has been slow, and there have been many rejections both for porosity and low physicals. The component parts of the piece shown were easy to cut or bend, and while the assembly may seem intricate the part has actually been simple to make. This part will shortly be subjected to a severe test, and is expected to show increased strength with a reduction in weight, while greater reliability is considered assured.

Fig. 15 is presented as typical of the method by which all elevating racks are now made. The extension at top is attached to facilitate set up for cutting teeth and is then removed. Many cast racks have been lost from porosity in the teeth developed in machining. By the use of ares made from plate or forging this loss of material and machine work is eliminated. The built up construction is quite easy and rapid.

In Fig. 16 is shown the welded track shoes used on the six wheeled truck for the multiple machine gun mount. All who have seen this track have commented on its lightness which was possible only by this construction. Severe test on the road has shown that the welded parts can be relied upon as there has been no failure of these in either

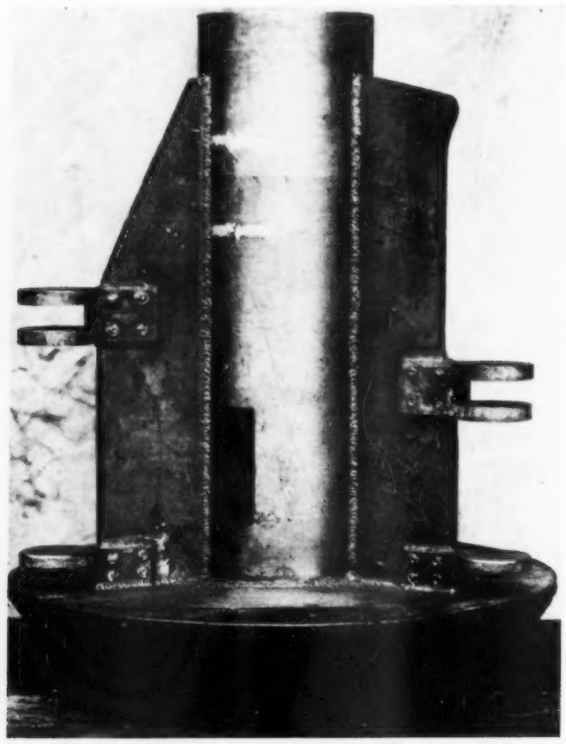

Fig. 12. Pedestal for 75-mm. Gun Carriage, T2.

track. Repetitive work of this kind can be handled nicely under the automatic feed in welding.

The jig shown in Fig. 17 is typical of a number that have been made in this way. The parts are, as in other work, cut to shape by torch with the automatic shape cutting machine. Strength here is not of primary importance and welding need only be sufficient to tie the parts securely. A good deal of scrap can be utilized while at the same time expensive patterns which as a rule would be

used only once are avoided. Such jigs are annealed and so far no change in form has been detected. Recoil guides are now attached to cannon by shrinking irregular hoops on the tube to form the guide. This practice is costly and increases weight. It has been felt practicable to weld these guides direct to the tube, and in Fig. 18 is shown a short section of gun tube to which wings suitable for guides have been welded. The parts as shown are larger than necessary and welding was made heavy so that by examination of cross sections the effect of excessive heat on the tube could be determined. Measurements taken before and after welding indicate that warping or change of diameter will be removed easily in final machining. The piece shown was held on supports 4.5 inches each side of the axis of tube (3-inch bore) and loaded to 186,000 lbs. before the piece failed along outer edge of the weld. This excessive strength indicates such guides can be adequately held with a light intermittent weld. This work is of course experimental, but eventual success in construction by this method seems quite probable.

The preceding illustrations represent fairly well the character of work that has been in progress at the Watertown Arsenal during the past ten months. Many other

Fig. 13. Top and Bottom Sleighs and Cradle for 75-mm. Pack Howitzer Carriage.

Fig. 14. Bogie Transom for 3-inch Antiaircraft Gun Carriage, M2.

examples might be included, but what has been presented indicates the field for such work. Plans are now being made to weld the caps and windshields to armor-piercing projectiles by arc welding and to manufacture bomb bodies by welding base and nose forgings to tubing.

A large capacity resistance butt-welding machine is being procured, and as soon as available it will be possible to continue welding by this process which offers numerous applications in the making of shell bodies, gun tubes, and parts now forged but which can be formed by welding together components of simple shape. This type of welding has not been touched on, but there is a wide field for employment which it has not been possible to explore with the existing equipment of low capacity.

IT may be claimed that in the preceding paragraphs only the bright side of welding has been presented and difficulties ignored. This is true and such has been the intention. Progress made has come only from close study of the

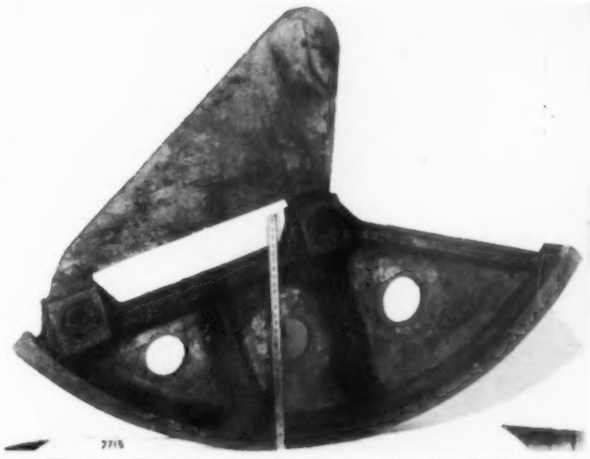

Fig. 15. Elevating Arc for 75-mm. Gun Carriage, T3.

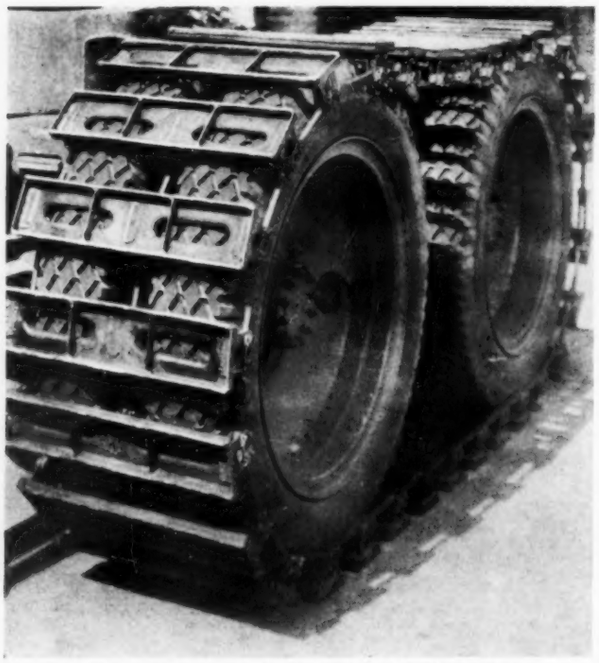

Fig. 16. Welded Track Shoes for Multiple Machine Gun Mount.

problems that come up daily in starting shops on a new process. It has been necessary for all those concerned in this work to exercise great care and skill in all work done and to seek continuously for the best methods. The fact that difficulties have been overcome is in itself sufficient answer, and in time any real difficulties will disappear. The main question is whether the process leads to an improvement in ordnance and in the production of ordnance.

Much could be said as to advantages of fabrication in time of war, as welders and welding facilities are increasing rapidly in number and quality, and it would be possible to subcontract for much work and to use such existing facilities with relief to our capacity for forgings and castings, always slow in delivery.

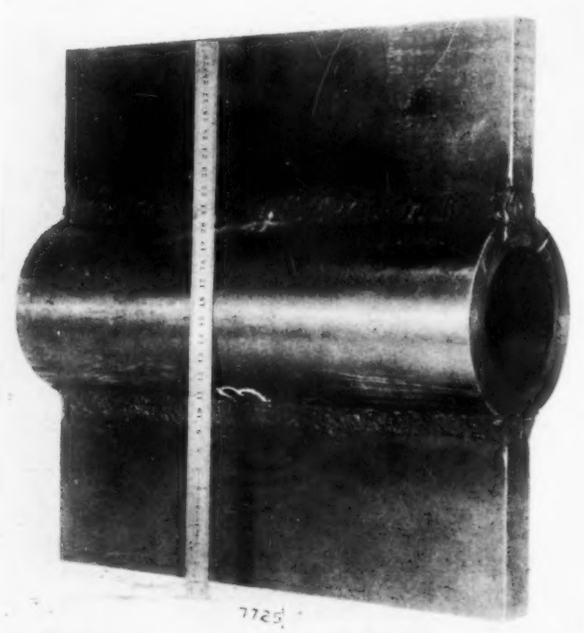

Fig. 18. Experimental Section of Gun Tube and Welded Recoil Guides.

It is not practicable in this paper to present a full statement of supporting facts, but it may be fairly claimed that utilization of fabrication by welding will lead in the production of ordnance to greater strength with less weight, greater reliability, quicker and economical production, less time and difficulty in repair, and to improvements in the design itself. Full application of the process will require a rather extensive redesign of existing ordnance should these types be continued in manufacture and it will be necessary in all new types to give this method primary consideration.

Editor's Note: In his address at the Eleventh Annual Meeting of the Army Ordnance Association, Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. Army, discussing the importance of welding in the manufacture of ordnance said, "It has become quite obvious that a very large percentage of cast and riveted components entering into artillery material can be made to advantage by using structural plate welded. Plate can be procured in quantity at two to three cents per pound while castings will cost from ten to sixteen cents, on the average. When building in small quantity, pattern construction is relatively very expensive and the Watertown Arsenal has, in addition, experienced extended delay in the delivery of castings followed by repeated rejections. It is not possible to generalize and state that welded construction is cheaper than casting or riveting, and each case must be considered on its own merits. The indications are, however, that after correct procedure has been established and the work systematized, welded construction will in general be cheaper and apparently more reliable than castings, which are always of uncertain quality. At the present time, we are constructing a large frame for a centrifugal casting machine which is made of plate from one to two inches in thickness, weighing in all about 15 tons. This machine is being fabricated entirely by welding and while costs are not available, it is believed welded fabrication of the frame of this machine, prior to machining, will not greatly exceed the cost of the pattern, while the material itself is costing certainly less than one-half that of the iron casting.

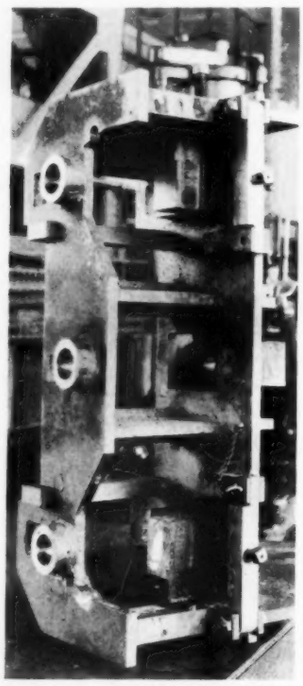

Fig. 17. Welded Shop Jig.

"There is now a marked trend toward greater use of welding in industrial work and the Ordnance Department can undoubtedly greatly improve much of its construction in this manner. Especially in all new design work, fabrication by welding should be always considered."

Searchlights and Sound Locators

Part I: Fundamentals of Antiaircraft Searchlight Projection

By R. E. Gillmor and P. R. Bassett*

Fig. 1. A defensive organization of modern combat and pursuit planes can prevent effective attacks from the air during daylight.

THE importance which aircraft will assume in future military operations is now universally understood and accepted. It is available to small as well as large countries; can act simultaneously with the declaration of hostilities and may immediately produce such destruction in poorly defended cities as to break down civil morale and bring about a decisive victory before other forces can become effective. Defense against aircraft has therefore become a subject of great military importance.

Development of defensive measures has taken place along two lines—the combat plane and the antiaircraft artillery. These developments began during the World War. At the close of the war, they were still crude but had advanced sufficiently to discourage daytime bombing raids. Since the war the remarkable developments in both combat planes and automatically controlled antiaircraft batteries have made it increasingly evident that daytime aerial attacks against well defended areas will seldom succeed. Therefore, it is to be expected that aircraft offensives against such areas will henceforth be carried out at night.

Night operations greatly increase the burden put upon the defensive organization. Both artillery and defensive aircraft are blind and helpless unless supplemented by efficient equipment for detecting and illuminating the attacking planes. For this reason the competition between the offensive and defensive weapons of aerial attack has reached a point where the searchlight organization is the limiting factor.

THE essence of the searchlight organization problem is *time*. Assuming that the listening devices (sound locators) are capable of detecting attacking aircraft at a range of ten miles, the *time* available before the oncoming aerial forces reach the boundary of their objective is a maximum of six minutes. During *this time* the sound locators must give the searchlights the approximate azimuth and elevation of the aerial enemy, the searchlights must find and illuminate them, the guns or combat planes must get "on" and the fire of the defending forces must become sufficiently effective to force the attacking planes to abandon their objective. To provide a *maximum* time for accomplishing all of this in any flying weather, it is necessary to have the maximum possible range in both searchlight and sound locator. It is also necessary to correct the sound locator for speed of plane, wind and parallax and to coördinate the searchlight automatically with the sound locator so that the target can be illuminated with the least possible *waste of time* for searching. And to these requirements must be added that of mobility for unless the entire equipment can be transported at high speeds over any kind of terrain, its use will be limited to the comparatively few areas where protected emplacements are possible.

THE characteristics of antiaircraft searchlights are affected to a considerable degree by the mobility of the lights. Some consideration of this feature should therefore precede a discussion of other characteristics. Should the equipment be mobile? What speed should it have? Will it suffice to make it capable of traversing military roads or must it be capable of traveling across country where there are no roads? These questions must be answered before we can discuss range, amperage and other points of design.

There seems to be but little difference of opinion as to the necessity for mobility. For operations with troops of course there can be no question. For the defense of fixed objectives, such as cities, waterways, railway junctions and coast fortifications, the use of mobile searchlights permits flexibility in the disposition of the defense, makes replacement of units more rapid and minimizes the danger of location and destruction by the enemy.

The questions relating to speed and ability to traverse unfavorable terrain have been decided by recent developments in mobile antiaircraft guns. These guns are now capable of traveling at speeds of 25 miles an hour and can

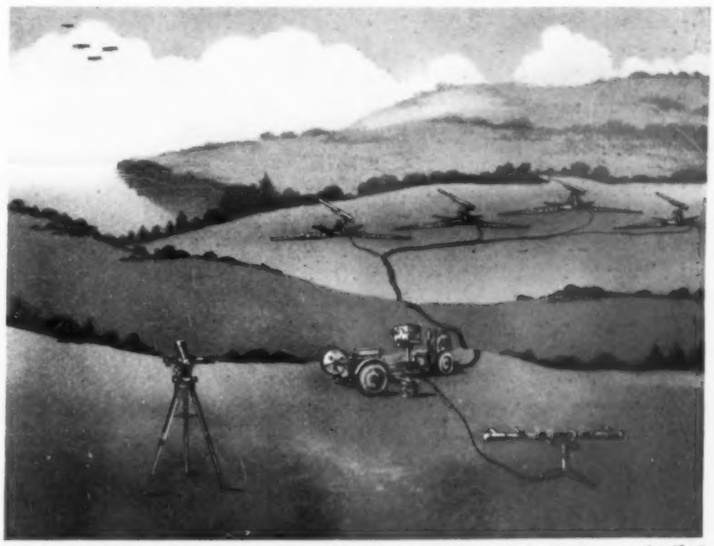

Fig. 2. Ground defense comprising modern antiaircraft batteries controlled by automatic directors provides further assurance that air raids must seek the cover of night.

*Vice-President and Chief Engineer respectively, Sperry Gyroscope Company, Inc., Brooklyn, N. Y.

traverse any terrain which is sufficiently firm to prevent the wheels from sinking. The searchlight equipment must be capable of equal mobility.

Mobility and range are seemingly conflicting factors. To attain the maximum in range we must employ a maximum size of mirror and a maximum power input to the arc. To be mobile the dimensions of the searchlight must be limited to those which will make it possible to traverse crowded military roads, pass under bridges and through tunnels and permit of rapid handling. Mobility also places some limitations on the power generating equipment.

This conflict between range and mobility has given rise to wide differences of opinion as to the characteristics of antiaircraft searchlights. Many military engineers regard mobility as secondary and argue for maximum range, for the use of 80-inch (202 cm.) mirrors, for arc amperage of 200, 300 or even 400. Others regard mobility as the prime consideration and propose employing 36-inch (92 cm.) or 44-inch (112 cm.) searchlights with arc amperage limited to 150. In supporting the latter contention it is argued

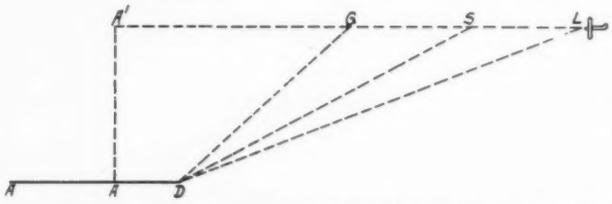

Fig. 4. The most important element in the antiaircraft problem is time. To obtain maximum time for the defense, it is necessary to have maximum range of searchlight and maximum saving of time in coordinating the searchlight with the sound locator.

AA—Defended areas; DL—Range of Sound Locator; DS—Range of Searchlight; DG—Range of Guns. For the average bombing plane, the time from L to A' is 6 minutes.

that the 36-inch (92 cm.) and 44-inch (112 cm.) lights have ranges equal to that of the antiaircraft guns and because of their smaller size and lower cost can be employed in larger numbers.

We believe that these differences of opinion can be removed by careful analysis of the problem. The data we are submitting will show that a selection of searchlight characteristics can be made with little or no conflict between range and mobility. It will be seen that an increase in beam candle power beyond a certain point is relatively valueless as there are certain inherent limitations to range which cannot be surmounted simply by using a more powerful light. On the other hand, it will be seen that the use of 44-inch (112 cm.) or 36-inch (92 cm.) searchlights instead of 60-inch (152 cm.) does not improve mobility to any useful extent but does reduce the range to such an extent as to render the searchlight completely ineffective when the atmospheric conditions are unfavorable.

THE range of a searchlight is the maximum distance at which an object in its beam is visible. The visibility of the object does not depend on its actual illumination but upon the contrast between its illumination and the illumination of the surrounding field.

The contrast between object and field which is necessary for visibility depends upon the apparent size of the object —i.e., upon the angle which it subtends at the eye of the observer and the area presented toward him. When the object is close, a contrast of a few percent is sufficient for

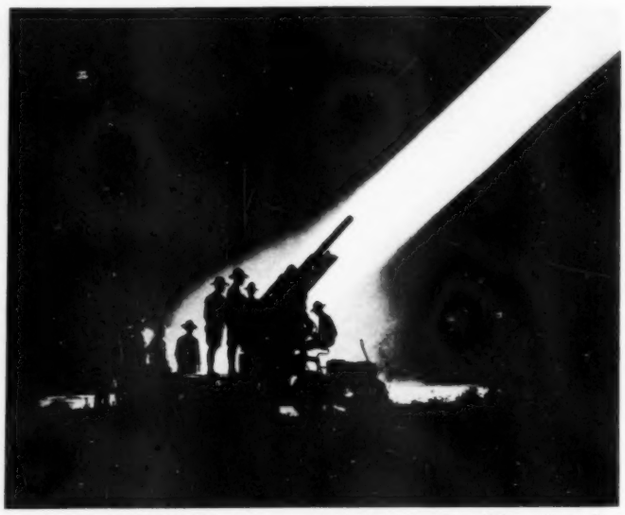

Fig. 3. Night defense by combat plane and artillery is helpless unless provided with means for locating and illuminating the attacking aircraft.

To provide flexibility in disposition of defense and to prevent location and destruction by the enemy, the searchlight and sound locator **must** be **mobile.**

visibility. When the object is far away and subtends a small angle, a contrast of several hundred percent is necessary to make the object visible.

As an example of the contrast necessary for the visibility of objects subtending small angles, consider two of our celestial neighbors—the moon and the planet Venus. The moon subtends an angle of 25 minutes which is about the same as a bombing plane at a range of 2,500 yards (2,300 meters). Venus subtends an agle of 1 minute, which corresponds to the angle subtended by a bombing plane at a range of 25,000 yards (23,000 meters).

On any clear day when both bodies are well above the horizon, we have conditions which are closely analogous to the illumination of aircraft targets by searchlight beams. The sun is the searchlight; it illuminates both objects and also the field. The blue sky is the field and is the exact

Fig. 5. Searchlight range (extreme limit of target visibility) depends upon the contrast between the illuminated target and the less illuminated beam.

counterpart of the searchlight beam—that is, light scattered by atmospheric dust between the target and the observer.

The contrast between the moon and the sunlit sky is about 2 to 1 and we can *easily* see it. Venus, due to its greater coefficient of reflection, has a contrast with the sky of 12 to 1 but because of the small angle it subtends, we *cannot* see it. In this case, therefore, it is evident that whereas a contrast of 100 percent is sufficient for large objects, a contrast of 1200 percent is insufficient for very small objects. The need for contrast is increased still further at the lower levels of illumination given by searchlight beams at extreme ranges. It is also increased when the plane is head on to the observer and therefore presents a small area.

The most obvious way of improving the contrast between the illuminated aircraft target and the searchlight beam is to move the controlling observer away from the searchlight and thus decrease the depth of illuminated atmospheric particles through which he sees the target. This has the effect of decreasing the luminosity of the field. Its value is illustrated in Fig. 6. All further data on searchlight ranges given in this series of articles are based upon the assumption of a favorable position for the observer as indicated in this figure.

With a view to obtaining quantitative information as to the contrast necessary for visibility of airplane targets, the engineers of Sperry Gyroscope Company have, during the past few years, conducted an elaborate series of laboratory and field observations. In the laboratory the aircraft target in the searchlight beam has been simulated by the use of small models on ground glass screens. The field observations have been carried out in coöperation with the Air Services and have included many hundreds of flights under a wide variety of weather conditions.

The space available in this article does not permit of submitting the voluminous data which have been accumulated on this point but it will suffice to say that the contrasts necessary to make a bombing plane visible in the searchlight beam extend from 2 to 1 at ranges of 2,000 yards (1,830 meters) up to 12 to 1 at ranges of 12,000 yards (11,000 meters). Therefore, to retain visibility, we should, for each doubling of the range, be able to increase greatly the illumination falling on the target. Unfortunately, however, the natural laws under which we are working bring about the opposite effect.

AS the aircraft target increases its range, the illumination falling on it decreases by reason of two factors—atmospheric absorption and spreading of the beam. Loss of light due to atmospheric absorption varies with the weather—from ten percent per mile in clear weather to complete absorption in fog. Loss due to spreading of the beam is the same for all conditions and follows the law of inverse squares—i.e., for each doubling of the distance the illumination is reduced to one-quarter. Spreading of the beam is due to the unavoidable fact that the source of light is an *area*, not a *point* and that therefore the lines of light in the beam must be slightly divergent (Fig. 16).

The luminosity of the beam against which the target is seen remains about the same irrespective of target range. This is because at all ranges the observer is looking through the same depth of illuminated atmospheric particles in front of and behind the target. Therefore, as the range increases we have the unfortunate situation of less contrast between the object and the surrounding field and at the same time a need for greater contrast because of the smaller and smaller angles subtended by the target. These two factors

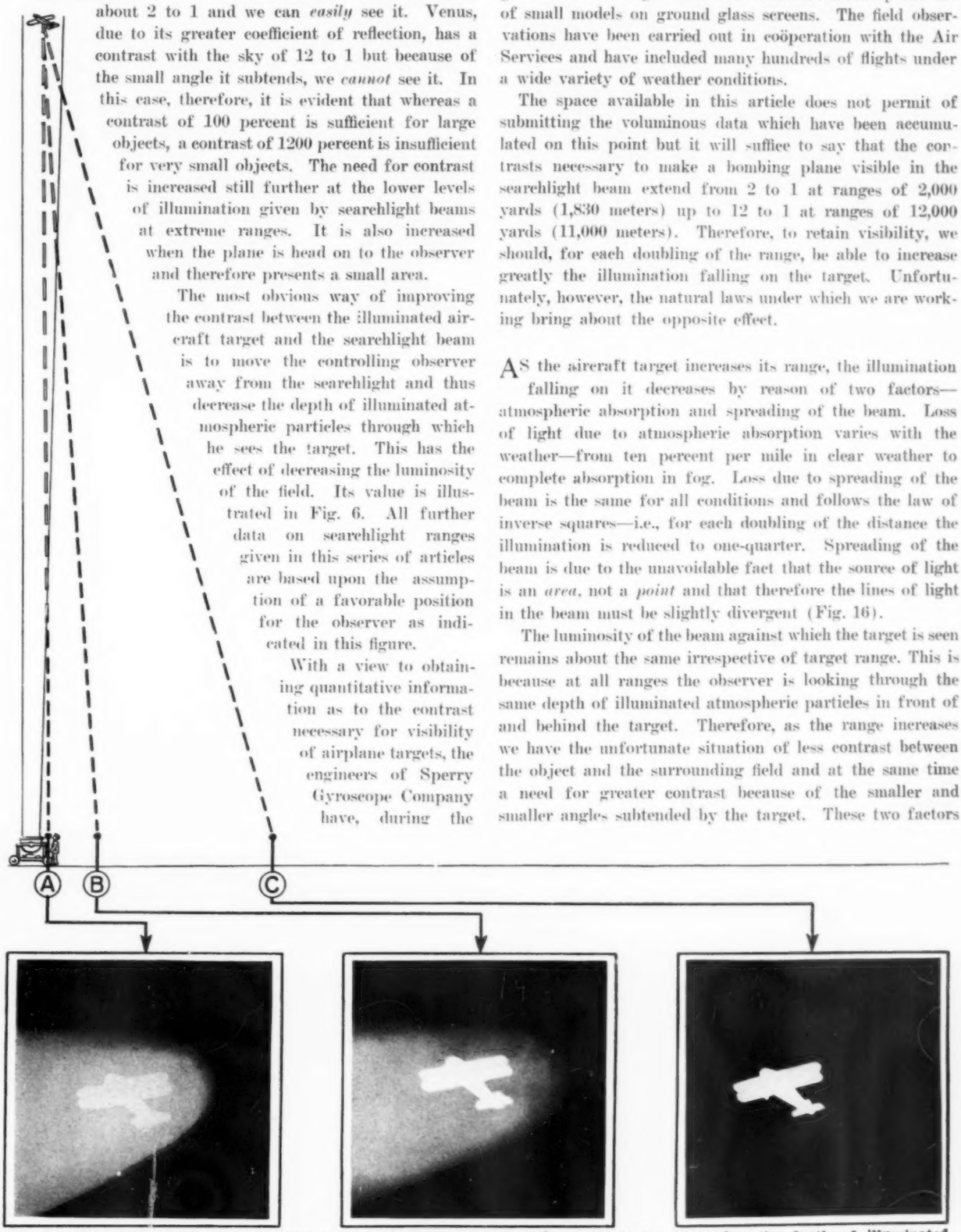

Fig. 6. Moving the observer to one side of the searchlight improves the contrast by decreasing the depth of illuminated atmospheric particles through which the target is observed.

B—Mechanical control position 15-feet (4.6 meters) from center of the searchlight; C—Distant electric control position 50-feet (15.25 meters) or more from the center of the searchlight.

Fig. 7. The illumination falling on the target decreases proportionately to the square of the distance.

operate together to impose sharp limitations on the range even though extremely powerful beams are used.

To determine these limitations our engineers, in coöperation with the military services, have for several years taken advantage of every opportunity to acquire data showing the relation between beam candle power and range under various atmospheric conditions. The summarized results are expressed by the curves shown in Fig. 11. These curves are based on averages of many hundreds of laboratory and field observations and are as accurate as the variations of human eyesight permit. The values for range were obtained against airplane targets painted with a neutral color such as olive drab. It was found by experiment, however, that the color of the airplane has very little effect on the range of the searchlight.

Moonlight has the effect of lowering all of these curves. This effect is due to the decrease in contrast produced by the illumination of the atmospheric particles through which the beam is seen. The relations for moonlight conditions cannot be graphically plotted as they are entirely dependent upon the degree of fullness of the moon, its height above the horizon and its position with relation to the target. When less than half full or when near the horizon, the moon has little or no effect on searchlight ranges. A full moon well above the horizon and near the target has a maximum effect. Under the latter conditions the curves shown in Fig. 11 would each be moved to the next lowest position—i.e, the curve for "clear weather" would occupy that for "slight haze" and the curve for "haze" would be flattened out to nearly zero range at all values of beam candle power.

The curves clearly show that the relation between beam

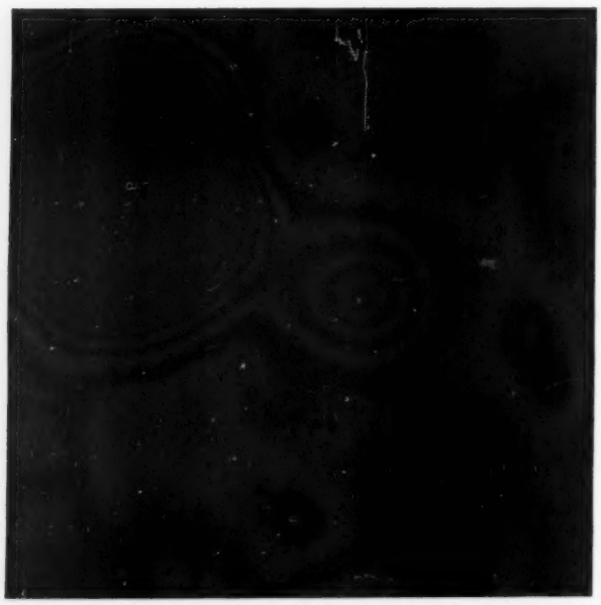

Fig. 8. As the range increases, the target subtends smaller angles and must have much greater contrast with its surrounding field to make it visible.

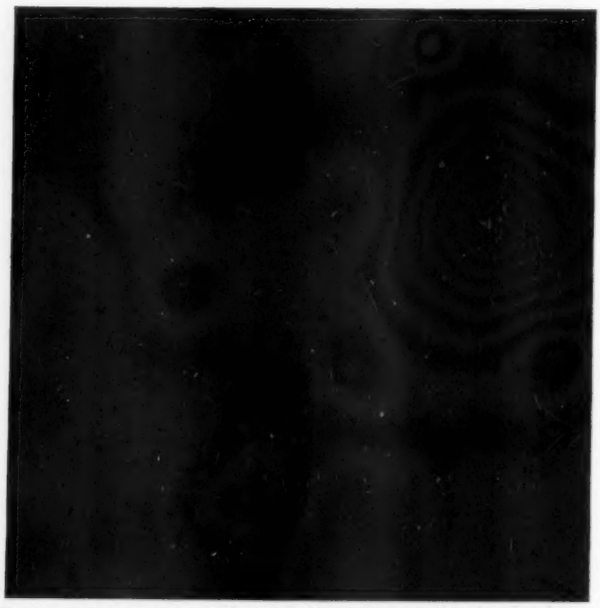

Fig. 9. As the range increases, the need for greater contrast combined with the rapid decrease in illumination of target combine to pinch out the visibility of the target.

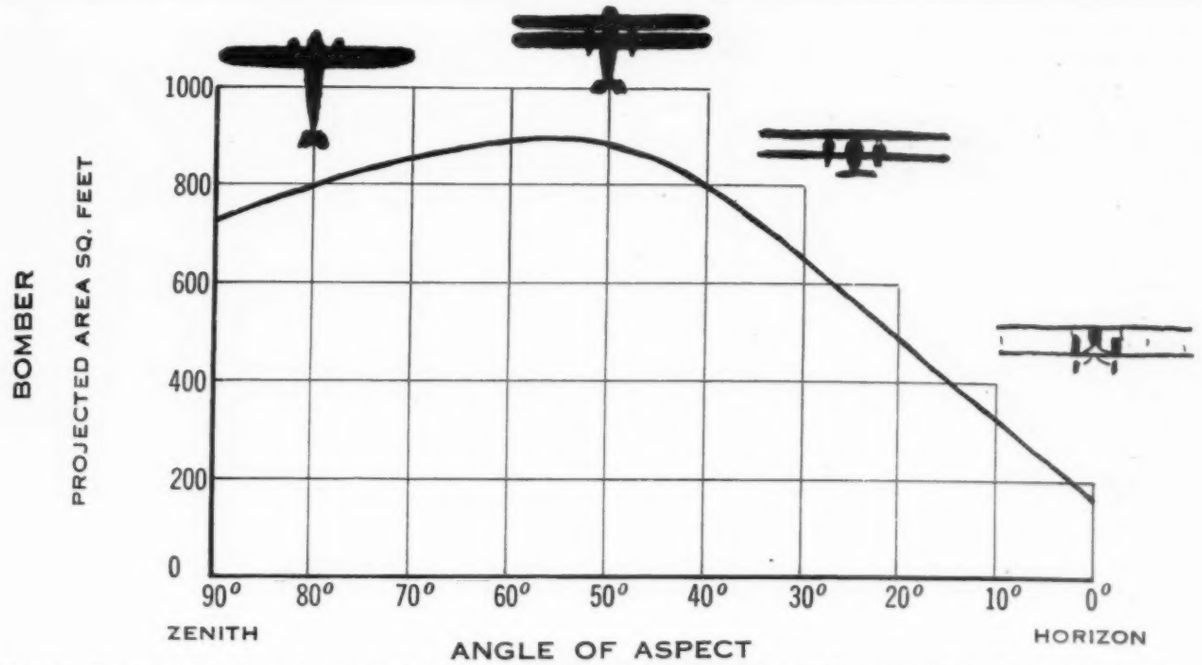

Fig. 10. The necessity of greater contrast may be increased still further by the smaller area which the target presents when approaching from a distance.

candle power and range is governed by a law of diminishing returns which begins to manifest itself at a candle power of about 700,000,000. Up to this point an increase in beam candle power results in a proportionate increase in range. After passing this point, increases in candle power produce less and less proportionate increase in range until at one billion beam candle power we find that further increases are quite valueless. This is due to the phenomena we have described in the preceding paragraphs, i.e., to the fact that as the range increases, the contrast necessary for visibility of small targets *increases* very rapidly while at the same time the illumination falling on the target *decreases* very rapidly without a corresponding decrease in the illuminated field against which the target is seen.

A STUDY of these curves is exteremely important to an intelligent selection of the amperage and size of mirror to be used in antiaircraft searchlights. For example, it is evident from the curves that the 36-inch (92 cm.) searchlight is unsuitable for antiaircraft purposes. Even in clear weather its range is dangerously short. In haze, when aircraft can still operate, the range of the 36-inch (92 cm.) searchlight is so short as to make it more of a help to the attacking planes than to the defending forces. To be effective under all atmospheric conditions, the antiaircraft searchlight must have a range within the zone of diminishing returns.

On the other hand, if we can reach the zone of diminishing returns with a mobile 60-inch (152 cm.) searchlight of moderate amperage, then we would *not* be justified in complicating our antiaircraft unit and rendering it less reliable by resorting to high amperage lamps or to mirrors larger than 60-inch (152 cm.). The use of a high amperage lamp makes it necessary to dissipate enormous values of heat from the lamp heads, decreases the time of burning of the carbons, adds a great deal to the size of generator and size of the cables and involves other disadvantages. The use of a mirror larger than 60-inches (152 cm.) involves the probability that the unit would not be able to pass under bridges or over the usual military roads.

Fortunately a mobile 60-inch (152 cm.) searchlight with a 150 ampere lamp will give a beam candle power well within the desired zone *provided* we employ the most efficient high intensity arc, keep the crater of that arc in the exact focus of the mirror and remove all fumes from the searchlight drum before they can be deposited on mirror or front door. The beam candle power reliably obtained from this searchlight under field conditions is somewhat more that 800 million. This value is well within the desired zone and gives a range so near the ultimate as to make further increase in beam candle power of doubtful value.

Before describing the Sperry Antiaircraft Searchlight, we will briefly discuss beam candle power and show how its value is affected by intensity of the source of light, size of mirror and accuracy with which the source is held in the focus of the mirror.

IN effect the searchlight mirror magnifies the light source to the diameter of the mirror. Therefore, if it were not for the absorption of light by the glass mirror, front door and shadow-making obstructions in the searchlight drum the beam candle power would be equal to the intrinsic brilliancy (candle power per square millimeter) of the light source, multiplied by the area of the mirror in square millimeters. Because of these absorptions and obstructions the actual beam candle power is about 60 percent of this product.

The intrinsic brilliancy of the light source is not uniform but is brightest at its center. As the beam is a magnification of the light source, it also has a central area of higher candle power than the average over its entire area. It has been found in practice, however, that the range of the searchlight is dependent upon the brightest central por-

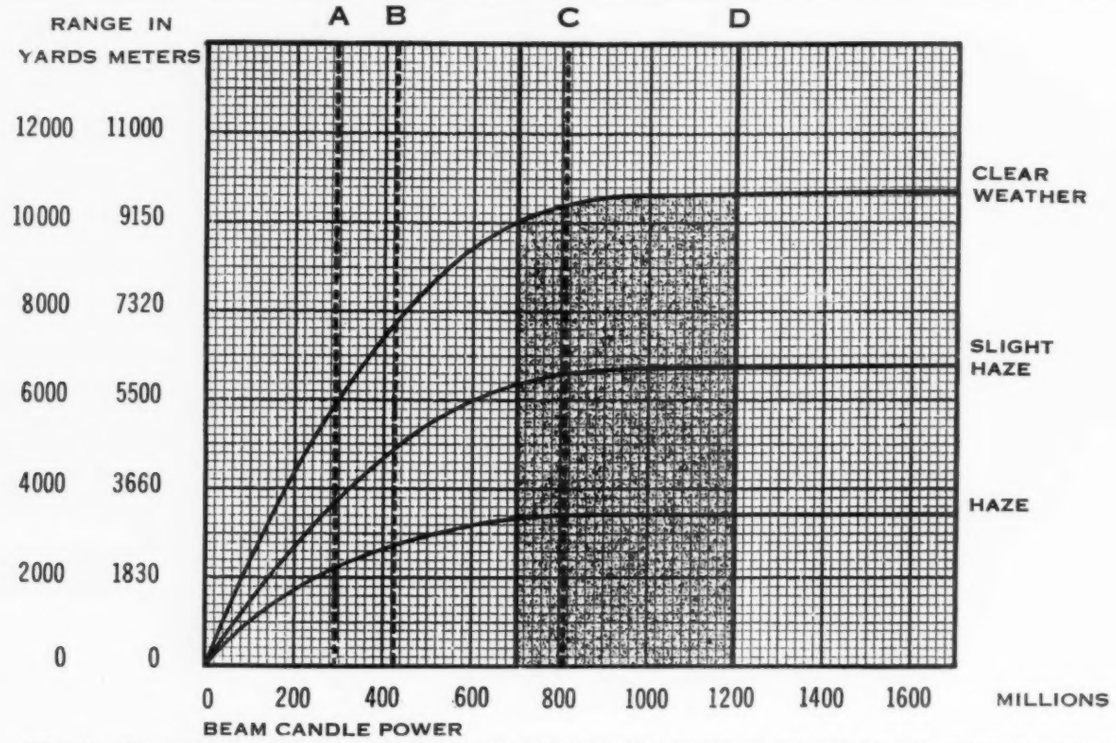

Fig. 11. The combined effects of decrease in illumination with increase in the need for greater contract produce the sharp limitation to range shown by these curves. For this reason, the shaded portion is a zone of diminishing returns. After reaching this zone, further increases in light give little increase in range. Therefore, maximum range is practically obtained with a beam candle power of 800,000,000.

A—150-ampere Arc 36-inch (92 cm.) Searchlight.
B—150-ampere Arc 44-inch (112 cm.) Searchlight.
C—150-ampere Arc 60-inch (152 cm.) Searchlight.
D—250-ampere Arc 60-inch (152 cm.) Searchlight.

tion of the beam rather than on the average beam candle power. Therefore in Fig. 11 and throughout this series of articles the values given for beam candle power are obtained by multiplying the intrinsic brilliancy of the central area of the light source by the area of the mirror and deducting 40 percent for absorption. If mirror and front door are perfectly clean, the actual absorption is considerably less than this but the figure of 40 percent is used to cover average conditions in the field.

It would be possible to obtain beam candle power by taking photometer readings in the beam at a measured distance and multiplying the candle power so obtained by the square of the distance from the light. Photometer readings made near the light would be erroneous, however, because, for reasons given later, the inverse square law does not hold good for positions near the searchlight. On the other hand, if the photometer readings were made at a considerable distance, inaccuracies would be introduced by the difficulty of accurately determining atmospheric absorption. The most satisfactory method, therefore, is to calculate the

Fig. 12. In the ordinary carbon arc the source of light is the surface of the tip of the positive carbon. The maximum intrinsic brilliancy obtainable from this surface is 160 candle power per square millimeter.

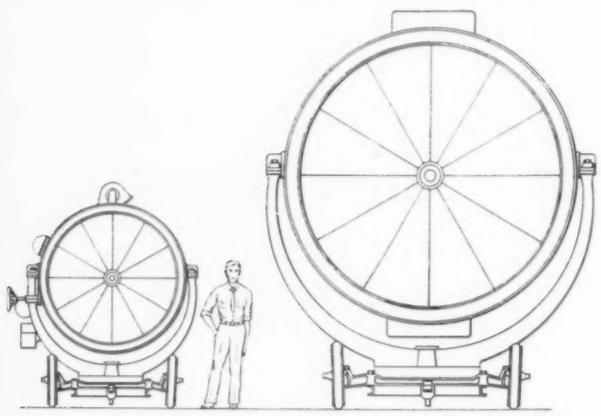

Fig. 13. To produce a beam candle power of 800,000,000, an ordinary carbon arc searchlight would have a diameter of 125 inches (319 cm.)—an impossible size for mobile lights. A 150 ampere high intensity arc will give the required 800,000,000 candle power with a mirror diameter of sixty inches.

Fig. 14. In the high intensity arc the source of light is a ball of luminous gas in the positive crater. This ball is translucent and the light is therefore derived from the depth as well as the surface. For this reason this arc produces an intrinsic brilliancy of 750 candle power per square millimeter.

values of beam candle power in the manner mentioned above. These values are then checked by photometer tests under very clear weather conditions.

We will now turn to a consideration of ways and means for obtaining the beam candle power which we have found to be best for effective antiaircraft purposes.

THE intrinsic brilliancy of the light source is a function of temperature. Therefore, in order to obtain a light source of maximum brilliance, a substance must be used which can be maintained at the highest possible temperature. Since carbon has the highest volatilizing point of any known solid, it was thought for many years that the carbon arc was capable of the greatest artificially obtainable intrinsic brilliancy. A carbon surface when heated near its volatilizing point gives forth a maximum of 160 candle power per square millimeter. This occurs at a temperature of about 3,000° C. Increasing the temperature beyond this point by forcing more current through the arc simply results in volatilizing the carbon more rapidly without increasing its intrinsic brilliancy.

If we attempted to use the ordinary carbon arc to obtain a beam candle power of 800,000,000, we should find that it would be necessary to employ a current through the arc of about 350 amperes and use a mirror having a diameter of 125 inches (318 cm.) Both of these requirements are out of the question for a mobile unit.

In observing the ordinary carbon arc, it will be seen that all the light comes from the *surface* of the tip of the positive carbon. It is quite true that this carbon surface is capable of the highest degree of incandescence of any known *solid*. We know from observations of the sun, however, that an incandescent *gas* is capable of a much higher intrinsic brilliancy than 160 candle power per square millimeter. The reason for this is that the gas is translucent and light is therefore derived from its *depth* as well as its surface. The Sperry High Intensity Arc is based on this phenomenon.

The incandescent ball of vapor which forms the source of light in the Sperry High Intensity Arc is derived from the rare earths cerium and lanthanum. By incorporating these earths in a relatively soft core of the positive carbon in precisely the right form and quantity and by forcing a high current density through the carbon, the earths are volatilized and projected into the crater.

To be useful as an intense source of light in the focus of a mirror, this brilliant vapor must be confined to a very small area. This is accomplished by so compounding the materials of the positive core that they volatilize a little more readily than the hard carbon shell, thus forming a deep crater. To keep the crater uniform the positive carbon is slowly rotated. To confine and compress the light-giving vapor in the positive crater, the negative carbon is so arranged that its flame sweeps across and impinges on the vapor.

Since light is obtained from the depth of the gas in the crater of the high intensity arc as well as from its surface, it produces an intrinsic brilliancy of 750 candle power per square millimeter. With this brilliancy in the light source, we see at once that even when allowing the generous absorption figure of 40 percent, we can obtain our desired beam candle power of 800,000,000 by using a mirror diameter of 60 inches (152 cm.), a positive carbon having a diameter of 16 mm., a current density of 1.5 amperes per square mm. and a total current through the arc of 150 amperes, all of which are quite feasible in a mobile searchlight.

Although increasing the current density would increase the weight, cost and complication of the antiaircraft unit, it would be quite feasible to make this increase provided a material advantage could be so obtained. It is therefore desirable to consider very carefully the effect of forcing more current through the high intensity arc.

The most readily available means for increasing current density is a decrease in the diameter of the positive carbon. We have found from careful field tests, however, that the diameter of 16 mm. mentioned above gives us the correct beam spread for antiaircraft purposes and that it is

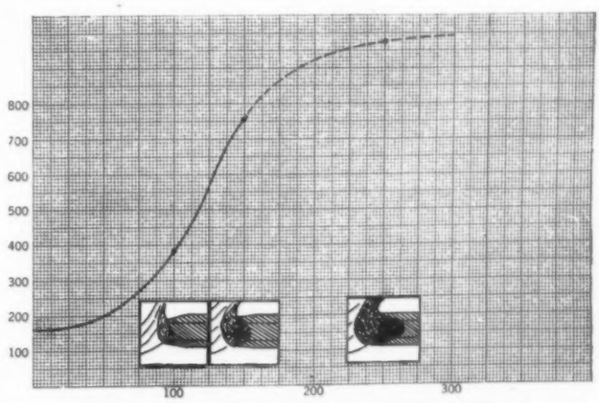

Fig. 15. The most suitable size of positive carbon for antiaircraft searchlights has a diameter of 16 mm.

When using this size of carbon, increases of current up to 150 amperes force more molecules of vapor into the crater and so increase the intrinsic brilliancy. Increases beyond 150 amperes are of doubtful value as they are accompanied by intense heat and a tendency toward unsteadiness of the arc. Increases beyond 250 amperes are valueless as at that point the vapor becomes so dense as to be opaque.

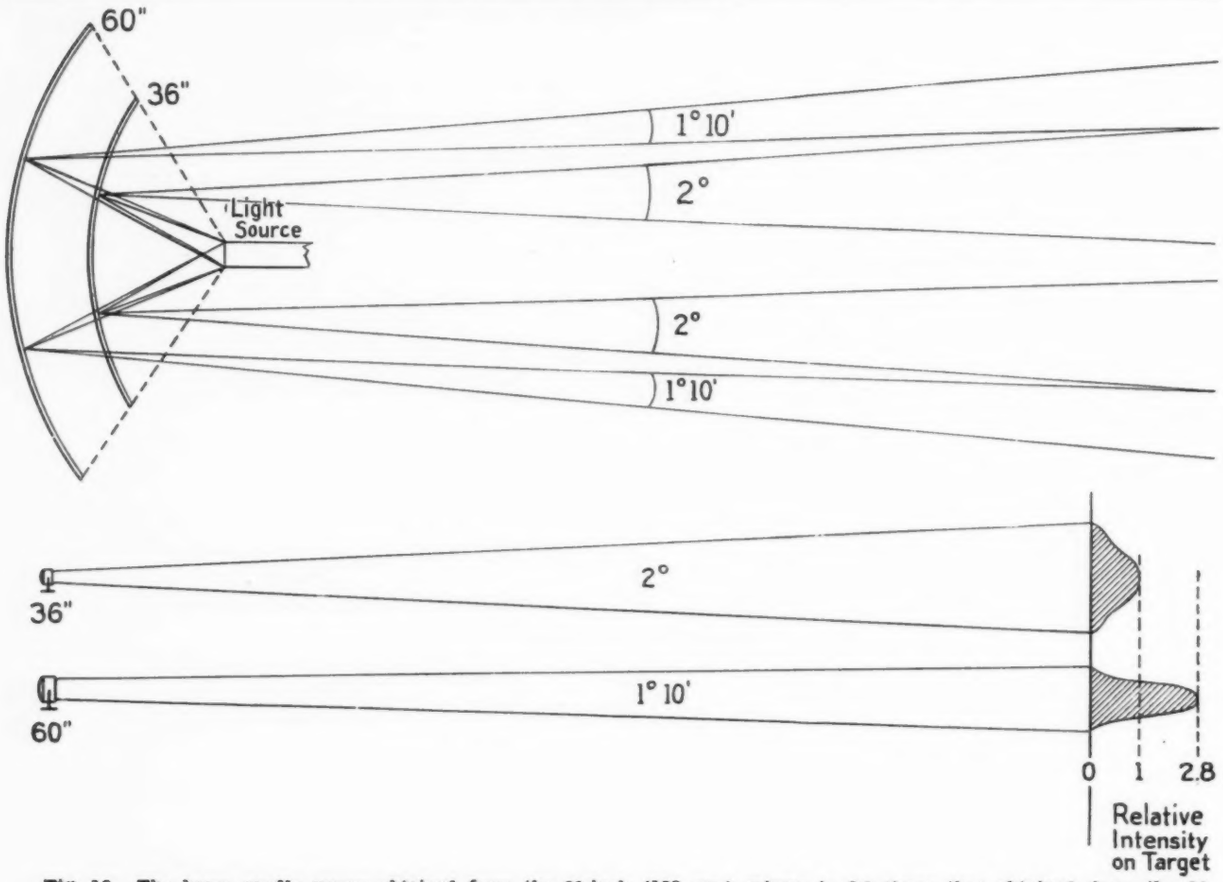

Fig. 16. The beam candle power obtained from the 60-inch (152 cm.) mirror is 2.8 times that obtained from the 36-inch (92 cm.) mirror. The 60-inch (152 cm.) mirror is the maximum size suitable for use with a mobile searchlight.

inadvisable to change it. Therefore to increase the current density we must increase the total current through the arc.

Laboratory tests show that increases of current up to 250 amperes are accompanied by a consistent increase in the intrinsic brilliancy. This is because the higher current density forces more molecules of gas into the crater, thus producing greater vapor density. Increases beyond 250 amperes are practically valueless as at that point the ball of vapor becomes so dense as to be opaque.

Field tests over a period of years show that the increased intrinsic brilliancy between 150 and 250 amperes is accompanied by certain elements of unreliability. The unreliability arises from the fact that beyond 150 amperes it is very difficult consistently to obtain steady burning of the carbons. It has also been found that because of the intense heat which must be radiated, it is necessary to take especial pains in the cleaning of all contact surfaces.

Much effort has been devoted to means for overcoming these disadvantages by design of lamp heads and by the use of special carbons but none of these efforts has been completely successful when tested over a long period of time. One interesting development involved the incorporation of finely divided metal in the positive core to increase its current-carrying capacity. It was found, however, that this caused bombardment and pitting of the mirror.

The increase in *range* obtained by going from 150 to 250 amperes is negligible for the reasons which have been discussed previously. We therefore have a situation where the use of currents beyond 150 amperes gives us no real advantage and involves several important disadvantages including increased weight and cost, excessively rapid burning of carbons and some unreliability of operation. The evidence is therefore very clearly in favor of the 150-ampere light.

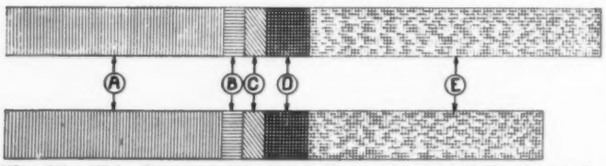

Fig. 17. This diagram compares the cost of 36-inch (92 cm.) and 60-inch (152 cm.) mobile searchlight equipments of equal quality.

The power unit, cable, generator and distant electrical control and lamp mechanism are common to both lights. Therefore, the 36-inch (92 cm.) light saves on drum and mirror only and cannot be justified on the ground of economy. A—Power Unit; B—Generator; C—Cable; D—Distant electric control; E—Searchlight.

HAVING found a source of light sufficiently brilliant to give the 800,000,000 beam candle power required for antiaircraft purposes, the next consideration must be the mirror. An increase in size of this mirror beyond 60 inches (152 cm.) would seriously interfere with the mobility of the searchlight unit. Therefore, any change in the mirror size must be in the direction of a smaller mirror rather than a larger one.

To understand the effect of size of mirror on beam candle power, it will be necessary to refer to the diagrams in Fig. 16. The beam can be regarded as composed of an infinite number of pencils of light originating with the light

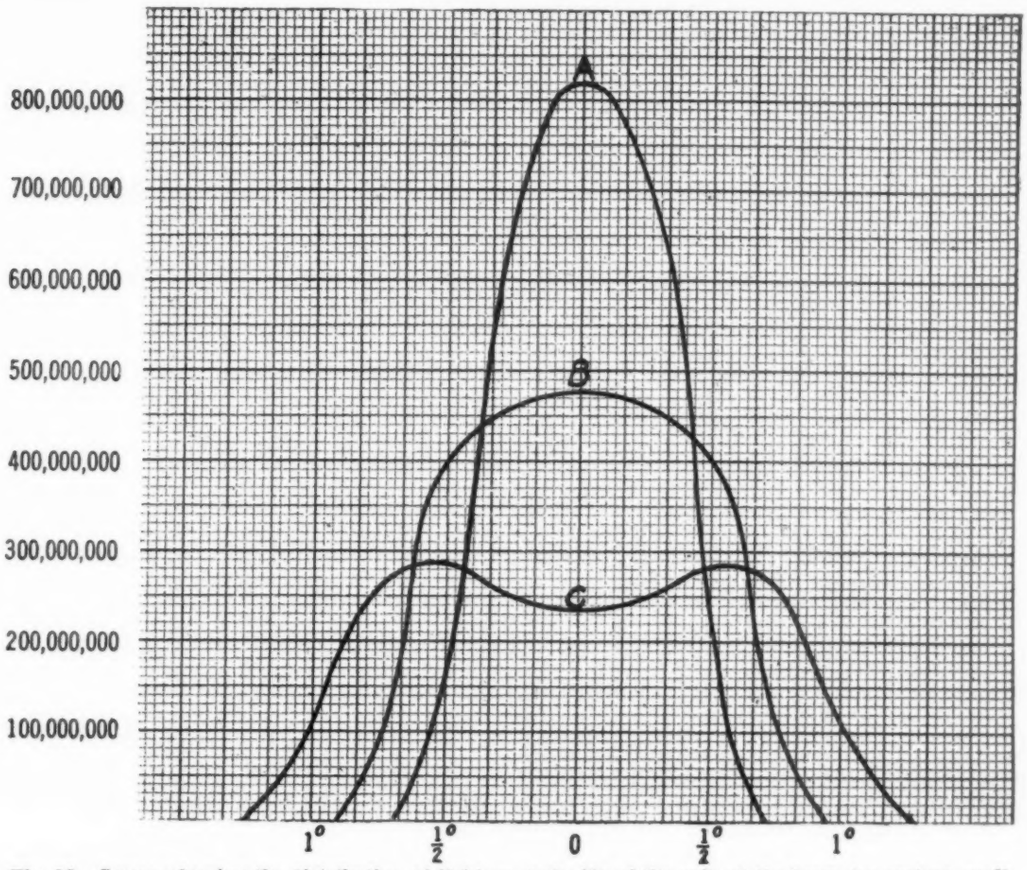

Fig. 18. Curves showing the distribution of light on each side of the axis of the beam for various conditions of focus.

A—in focus; B—⅛-inch (3.2 mm.) out of focus; and C—¼-inch (6.4 mm.) out of focus. A comparatively small out of focus condition produces such loss of beam candle power as to reduce a 60-inch (152 cm.) searchlight to the value of a 36-inch (92 cm.). Automatic, precision focusing is therefore very important.

source. These infinitely numerous pencils are gathered by the mirror and are eventually superimposed on each other to form the beam.

To obtain the least beam spread and therefore the greatest beam candle power, the light source in every case must be placed at the focus of the mirror. The mirror should be so designed that with the light source at its focus, the edge of the mirror subtends an angle which takes in as much as possible of the useful light emitted from the source. It has been found from experience that the most effective combination is a parabolic mirror, subtending an angle of 120° and a positive crater with an angle of emission of 120°.

A consideration of Fig. 16 shows why photometer readings taken near the searchlight are inaccurate. It will be seen that at locations near the searchlight the pencils of light have not become superimposed on each other and therefore photometer readings taken at these locations are measuring only part of the light. This figure also makes it evident that the spread of the beam and consequent loss of light in proportion to the square of the distance is an unavoidable result of the fact that the light source is an area and not a point.

It might appear from the diagram that by using a 36-inch (92 cm.) mirror with the same focal distance as the 60-inch (152 cm.) mirror we could obtain a beam spread of one degree and therefore a beam intensity equal to that of the 60-inch (152 cm.). To realize the fallacy of this statement it is necessary to remember that the beam is made up of an infinite number of the small pencils indicated in the diagram and that the intensity on the target is due to the summation of all of these pencils superimposed on each other. If we reduce the number of pencils by reducing the area of the mirror, we reduce the beam intensity to a corresponding extent.

It is fundamental therefore that the beam candle power is proportional to the area of the mirror but since we cannot obtain something for nothing, the increase in beam candle power resulting from an increase in size of the mirror is obtained at the expense of the size of the beam—the larger the mirror, the smaller the beam. It has been found from experience that a one-degree beam is quite satisfactory for antiaircraft purposes. Consequently, the use of a 60-inch (152 cm.) mirror gives a beam of satisfactory size and a beam candle power 2.8 times that given by a 36-inch (92 cm.) mirror. The range of the 60-inch (152 cm.) searchlight is fully 80 percent greater than that of the 36-inch (92 cm.). This difference is so large that the 36-inch (92 cm.) searchlight is out of the question unless the economies in weight and cost resulting from its use would permit employing three of four 36-inch (92 cm.) in place of one 60-inch (152 cm.) searchlight.

A comparison of the relative weight of 36-inch (92 cm.) and 60-inch (152 cm.) mobile searchlight equipments is given in Fig. 17. If the two sizes are of equal quality in

design and manufacture, the cost will be roughly proportional to the weight.

The two searchlights use the same amperage in the lamp. The generator must therefore be the same for both. The power for driving this generator is obtained from the engine of the truck which transports the light. The size of the truck is largely determined by the power of the engine. Consequently the same truck (power unit) would be used for both lights. The distant electrical control and cable are the same. The saving is therefore confined to the drum and mirror of the searchlight.

The total saving resulting from the reduction in size of mirror is 9.6 percent. This figure will become still more unfavorable when we add to the mobile unit the sound locator and comparator. It is evident without further argument, that a sacrifice of 50 percent in range to gain an economy of 9.6 percent in weight and cost is not justifiable.

Having analyzed the means for obtaining 800,000,000 beam candle power, it is now desirable to consider methods for keeping it. The most important cause of loss of beam intensity is out-of-focus condition of the light source. The curves given in Fig. 18 show how serious this can be. Curve A shows the distribution of light in the beam when the lamp is in focus. Under this condition the center portion has a value of 800,000,000, and the beam spread is a little over one degree. An out-of-focus condition of only $\frac{1}{8}$ inch (3.2 mm.) brings about the distribution shown in Curve B—a reduction of maximum beam candle power of 40 percent and a reduction in range of at least 20 percent. A $\frac{1}{4}$-inch (6.4 mm.) out-of-focus reduces the 60-inch (152 cm.) searchlight to the value of a 36-inch—a value which is inadequate for antiaircraft purposes.

It is evident from these curves that special attention must be given to maintaining the positive crater within 1/32-inch (.8 mm.) of the focus of the mirror. The means adopted for this purpose must be entirely automatic as maintenance of focus by hand is not sufficiently precise even under the calm conditions of peace-time practice.

Two other fruitful sources of loss of candle power under field conditions are sputtering or unsteadiness of the arc and deposits on the mirror and front door. Unsteadiness of the arc is almost entirely due to excessive current density and is avoided by not allowing the current through the arc to exceed 150 amperes. The principal source of light-absorbing deposits on the mirror and front door glass is the vapor given off by the high intensity arc. A ventilating system must be provided which will continuously sweep the glass surfaces with fresh air without creating currents which interfere with the functioning of the arc.

Reviewing and summarizing the data given in the preceding paragraphs, we see that the antiaircraft searchlight should have the following characteristics: First: Mobility with maximum speed of 40 miles (65 kilometers) per hour and ability to traverse any firm terrain. Second: A high intensity arc as the source of light. Third: A current through the arc not to exceed a density of 1.5 amperes per square mm. or a total of 150 amperes. Fourth: Precise automatic focusing of positive crater. Fifth: Ventilating system for cleaning mirror and front door glass. Sixth: Distant electrical control.

We can now proceed to a description of the Sperry antiaircraft searchlight unit and a consideration of the means employed in it for meeting these requirements.

(Part II of this discussion will be published in the next issue.)

The Radio Telephone in Aircraft Defense

LATEST developments in Army air tactics and equipment will be put to the acid test of practical application in course of the Air Corps field exercises to be staged at Sacramento, Calif., from April 1st until about April 26th. These trials will include tactical methods evolved during the past year and also various types of equipment of wide appeal to the public imagination.

Prominent among the newest departures in the latter field is the radio telephone which permits two-way conversation not only between ground and plane but also from plane to plane. Apparatus used on bombardment, attack and observation planes covers ranges of more than 35 miles, while pursuit planes can maintain vocal communication over distances of from 15 to 20 miles. Regular telegraphic equipment, also installed, has a much longer reach.

The scientific feat of executing verbal orders to pursuit planes rushing through space at speeds of three miles a minute, holding conversation with huge bombers rumbling through the air at the rate of 125 miles an hour or receiving verbal reports from fast observation planes high in the air and far away has never been attempted on the extensive scale arranged for by the Air Corps this year.

"We expect some interesting results from these tests," was the comment of Assistant Secretary of War, F. Trubee Davison, in charge of Army aviation. "This method of aerial communication is still highly experimental, but it is a long step forward from the day when pilots dropped messages in tubes and received instructions by means of panels placed on the ground.

"Development of radio as an adjunct to aeronautics is of value not alone in a military sense but also to commercial aviation. An interesting feature of the coming radio tests is that they will be conducted on wave lengths within reach of the average home radio owner who will be able to hear orders issued to and reports delivered from Army planes. Of course this novel experience will be confined to residents of localities near which the planes are operating.

"Other interesting features of the field exercises will be smoke screens, smoke curtains, phosphor bombs, flares and night photographic missions," continued Mr. Davison. "The latter are rather spectacular as they include the use of mammoth flashlight bombs of 5,000,000 candle power which, for one brief moment, turn darkness into day."

A Successful Baby Tank

The Carden Loyd—Forerunner of Light Automotive Weapons

By Robert J. Icks*

THE Carden Loyd tankette was first exhibited in Kensington about September, 1925, but the thought which gave it birth goes back several years before that time. General Estienne of the French Army was the first man who dreamed of such an armored vehicle, but automotive development had not reached a high enough plane in 1915 to achieve anything smaller than the Renault. At the end of the war, a certain group in England, headed principally by Col. J. F. C. Fuller, revived the idea of the small one-man tank.

Such a small tank was suggested by the Carden Loyd tractor firm and a model was built. This tank was equipped with a Ford engine and transmission and possessed a primitive type of suspension in that there were no springs or rollers. Naturally it was very rough in riding qualities and while it ran fairly well on soft ground, it had a tendency to gallop on hard ground. The track was an ordinary conveyor chain and its life was only about twenty miles. The driver sat on the axle casing with a leg on either side of the engine—a rather warm position. Steering and braking were accomplished by foot pedals actuating brake drums mounted on the axle. Gears were shifted by means of a lever similar to the joystick used in airplanes. The tank was extremely light, weighing but 700 pounds.

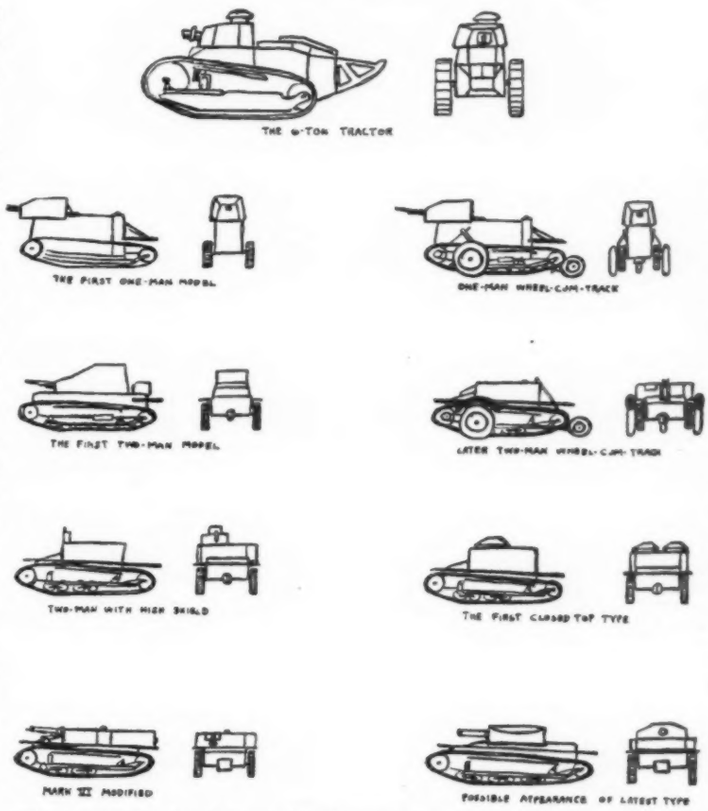

Fig. 1. Carden Loyd Tankettes Compared in Size to the 6-ton Tractor.

It captured the imagination of the British War Office and several more were built with an improved track running on a number of lightly sprung rollers. This is the model on which the wheel-cum-track principal was first tried. The Morris-Martel and Carden Loyd types were thoroughly tested and the one-man tank was officially abandoned as it was found that one man could not handle the machine and a weapon at the same time. Experiment then tended toward the two-man type.

THE first Carden Loyd two-man tank was slightly higher than the present models and had the same suspension as the later one-man tanks. During this developmental period, the greatest trouble was given by the track which wore out quickly and stretched badly. The track finally adopted is composed of 120 drop-forged steel links of one-piece construction. The links are keyed together in some such fashion as indicated in Fig. 4. The two projecting lugs act as retaining guides over the sprockets and idlers preventing the track from being thrown off at high speeds.

With the new track came a new suspension device, four 10-inch diameter soft rubber rollers on a solid frame and employing no springs. The track held up re-

Fig. 2. The One-Man Wheel-cum-track Tankette.

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markably well, having a life of some 600 miles, but the rubber rollers wore out quickly and the tank was very uncomfortable and rough riding. The present suspension scheme is well adapted to the functions of the vehicle. It consists of four rollers mounted in pairs so that each pair is free to rock on a connecting flat leaf spring. The pressure on the track is kept constant and the suspension and track are working out satisfactorily with the track having a life of a thousand miles or more.

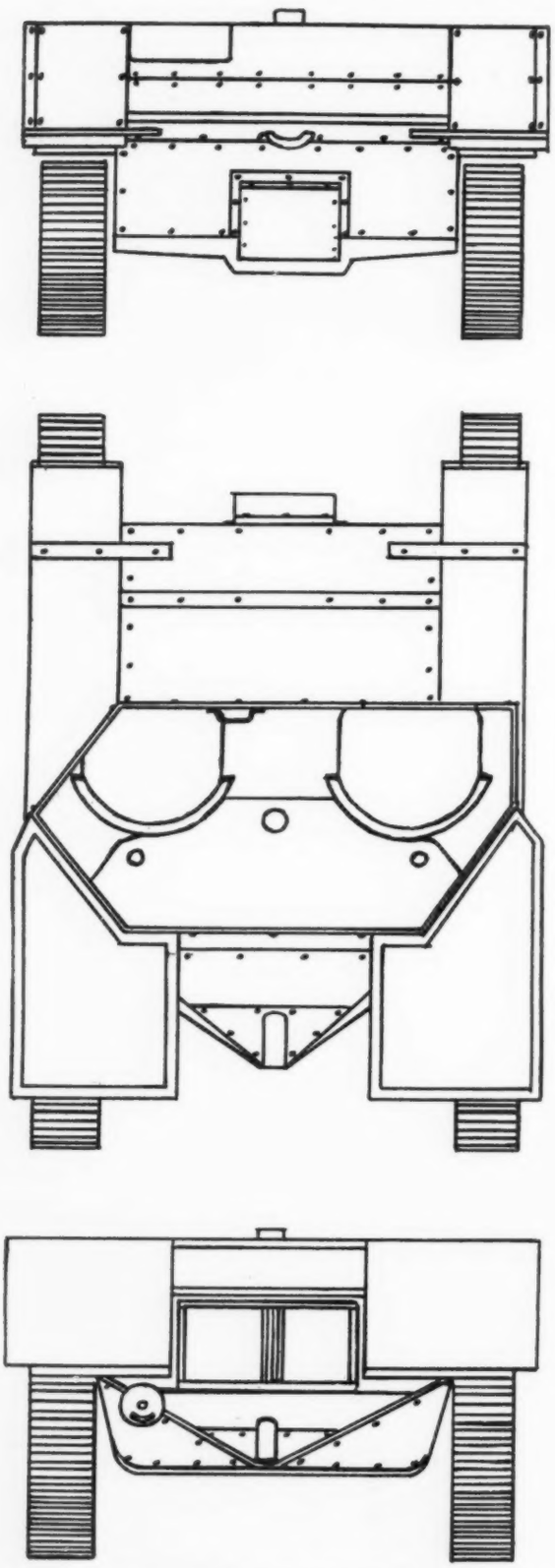


Fig. 3. Front, Top and Rear Sketches of the Carden Loyd

The wheel-cum-track principle was applied to the two-man tank as well as the one-man. The two large wheels on the sides and the smaller wheel in the rear could be dropped on crank arms by means of a screw in the front and one in the rear. In running on wheels, the power was transmitted through the drive sprockets by means of a chain drive to the large wheels. Steering was accomplished by braking as in running on tracks. The shift from wheels to tracks and return could be managed quickly from the inside but the mechanism was delicate and vulnerable and the tank rode roughly on wheels. Springing could not be used because of the small amount of track clearance.

Other forms appeared with high shields and at least one model had two small pyramidal turrets or covers which were hinged from the rear of the closed top. The standard vehicle at present appears to be the Mark VI, several views of which are sketched in Fig. 3. This model is equipped with extra space behind the fighting compartment in two boxes which can be detached.

A GREAT deal of ingenuity is apparent in the design and arrangement of this tiny tank. The tracks are equipped with fenders or mudguards which are essential in a fast track-laying vehicle. The drive is front and the differential in later models is protected by an armored box which is removable for maintenance purposes. The front drive arrangement is an excellent one in that dirt, mud and stones are thrown clear of the track before reaching the drive sprockets.

The fighting compartment is roomier than would be expected in a vehicle of this size. The driver on the left and the gunner on the right sit in curved-back seats which aid them in bracing themselves against the motion of the tank. Their legs extend beneath the cowling where, on the driver's side are located the standard Ford foot pedals and a lever for engaging the reduction gears. A lever at the right of the driver controls the epicyclic transmission. Another right hand lever is used for steering. Moving the lever forward produces a right turn and pulling it backward, a left turn, with an ease which permits complete turning in a space of thirteen feet.

The steering arrangement is simple. It is a well known fact that either rear wheel in an automobile can be stopped while the other will continue to revolve due to the mechanism of the differential. Steering in the Carden Loyd makes use of that principle by controlling the drive to either track by brake drums operated by the steering lever.

Directly behind the two seats are the tanks for gasoline and oil and the radiator, while the engine, properly shielded, is located in the center between and below the seats. In the rear, and outside, the radiator appears, protected by double doors which can be opened or closed at will. Below the radiator, the frame ends in a truss upon which is a large pintle for towing. To the left of the radiator is the muffler.

The armor on the vertical surface is .35-inch and on all other surfaces .24-inch, which is remarkable considering the total weight. Eyeslits are provided for the driver on both the front and beveled panels and for the gunner on the side panel.

Normally the heads of the crew project above the tank but they have sufficient room to slump down slightly to secure the protection of the armor which is proof against rifle fire.

The machine-gun mount is a simple one, pivoted at three points, making it quickly available for various types of fire as well as for rapid dismounting. (Fig. 5). Without modification it could not be used with a closed top but in the open-top type it would seem to be quite effective.

In addition to the fighting vehicle there is also a tractor form which is used as a machine gun carrier and in the manner indicated in Fig. 5 as a tractor for hauling the caliber .8 antitank machine gun or a caliber 3.7 cavalry accompanying howitzer. When the caliber .5 machine gun is carried, it is mounted on the tractor itself. Several batteries of both the howitzers and the 3-inch mortars are in existence. This latter is intended for use as an infantry accompanying weapon throwing both high explosive and smoke shell. The track has been applied to trailers and gun carriages as will be apparent from the photo, and the unit has been reported as being "very workmanlike, inconspicuous and self-contained."

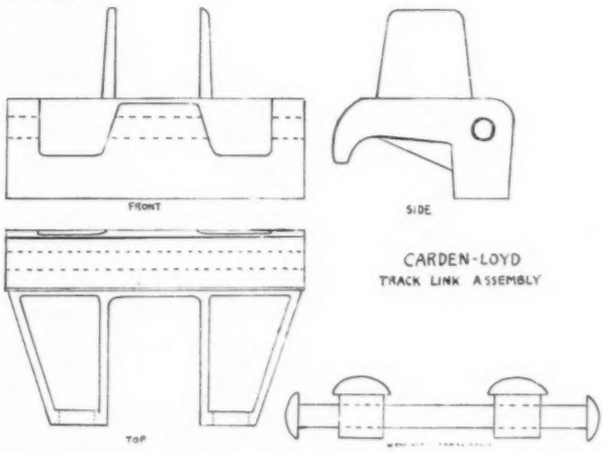


Fig. 4. Sketch of Carden Loyd Track Link Assembly.

ON the whole, the Carden Loyd is a very satisfactory vehicle. It is simple, cheap, and inconspicuous. The center of gravity is so low and the articulation so good that tipping is practically impossible. In speed, it will accomplish between 25 and 30 miles per hour and is mechanically reliable in spite of that speed. It weighs 2500 pounds and is 8 feet 1 inch long, 5 feet 7 inches wide, and 3 feet 4 inches high, has a gasoline capacity of 6½ gallons and will average 8 miles to the gallon. It will cross a vertical obstacle of 2 feet and ford water up to 1 foot 6 inches. Because of its size and weight it is naturally a somewhat unstable gun mount but less so than would be expected.

Fig. 6. The Carden Loyd Compared with People of Average Size. Note Martel Tank in Background.

There is every reason to believe that it is the forerunner of a very good, truly light, tank. The Imperial General Staff laid down specifications based upon the experience gained from the Carden Loyd and the first model appeared in 1929 designed from those specifications. While little is known of this new model, it is understood to have a single turret and a closed top and will cross a ditch four feet wide. The older models will cross a space about two and a half feet in width and it may be assumed from this that the track contains one more set of rollers on either side. This tank is being redesigned and others of the new type will be built.

While the Carden Loyd is not the last word in light tanks, there is no question but that it is very successful and versatile. A baby tank, but grown up in its achievements and potentialities, it is a most interesting vehicle.

(Editor's Note: For supplementary information regarding the Carden Loyd machines readers are referred to the article "Mechanization in Europe," Part II, by C. C. Benson, which was published in the November-December, 1929, issue of this Journal, Vol. X, No. 57.)

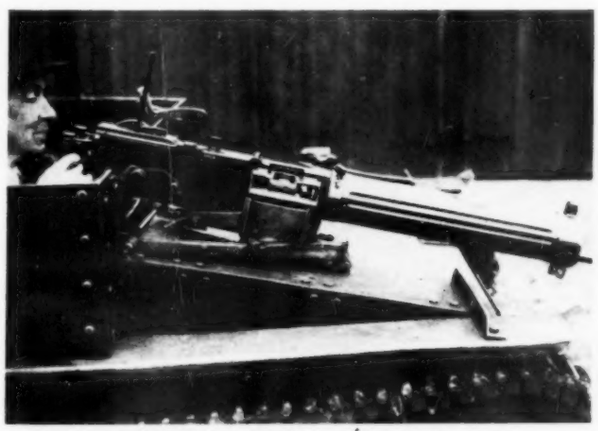


Fig. 5. Machine Gun Mounted on the Carden Loyd.

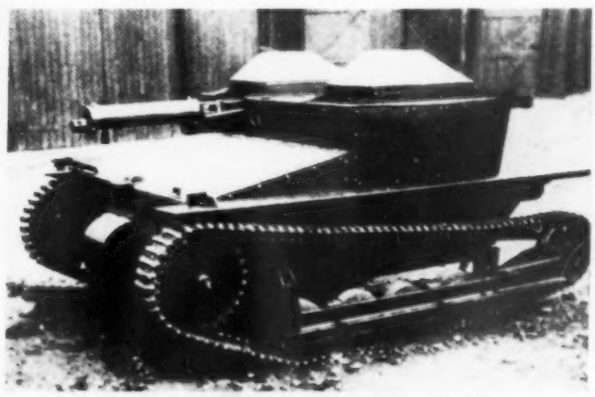


Fig. 7. Closed Top Model Carden Loyd.

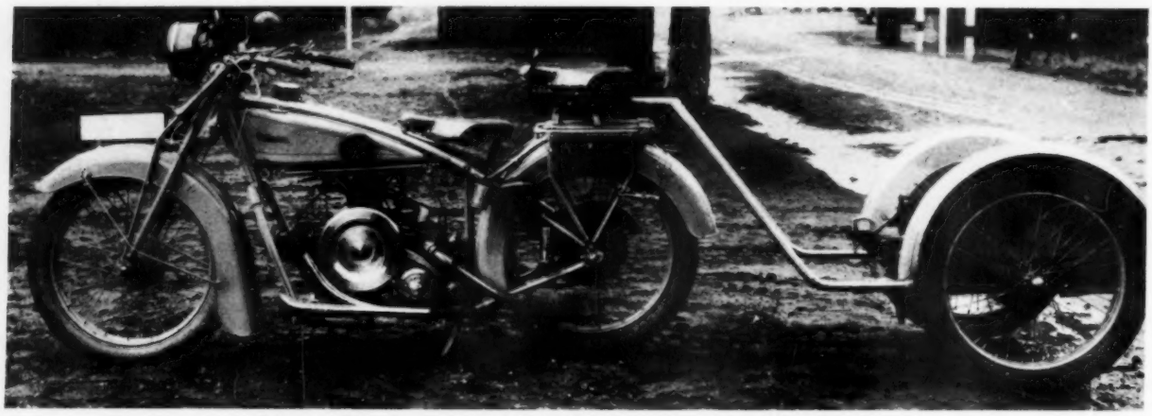


Fig. 1. The Commercial Victoria Motorcycle with Light Trailer

Commercial Motor Vehicles in War

Their Significance in the Mechanization of Armies

By W. Kempf*

MAJOR General C. C. Williams, Chief of Ordnance, U. S. Army, in his article "Mechanization" in the March-April, 1929, issue of ARMY ORDNANCE (Vol. IX, No. 53), stated: "The first and controlling thought in all items of ordnance equipment for the Army should be, and is, their availability and possibility of procurement in time of an emergency. The ideal would be to employ nothing but vehicles to be found in large commercial production."

The correctness of this principle cannot be denied when one considers the extraordinary large amounts of money which are required to produce specially constructed motor vehicles which can only be used for military purposes and must therefore in times of peace be classed as unproductive. It must be especially recognized that a military motor vehicle cannot, like a standardized field wagon, be placed in a depot, there to await for years the day when it will be required. Technical development is so rapid that a motor vehicle is rendered obsolete in a comparatively short time. A machine, which a few short years ago was looked upon as a wonder, may today be only junk. Consider that the time required for the design and construction of a modern tank and armored car is some two years. I believe that I am safe in saying that such a vehicle, on the day on which it moves for the first time under its own power, is no longer of the most modern construction in all its parts.

On these grounds it will be necessary for the armies of all countries, and especially those which are in the less favorable financial position, carefully to consider every means whereby the motorization and mechanization of the army can be built up on a basis of those kinds of motor vehicles which are in commercial use.

In the following lines consideration will be given to the methods by which each type of vehicle which is commercially available can be adapted for military purposes. In this discussion I will not concern myself with the use of motor vehicles in the service of supply.

THE MOTORCYCLE. The use of this vehicle for intelligence and messenger services needs no special consideration. The excellent services which it has rendered in these fields are, in general, well known.

I am, however, of the opinion that an attempt must be made to make further use of the motorcycle as this, the vehicle of the small man, is available in extremely large numbers over the whole world.

Studies must therefore be made and test must be conducted to determine whether, a modern army cannot in the event of a war make use of the motorcycle in reconnoissance service and to give mobility to complete fighting units.

In reconnoissance its use must remain very limited as it is in general confined to the roads. Furthermore, through the noise of the motor and the necessity for steering the machine, the rider's observing power through both his eyes and ears is diminished. These latter evils can, however, to a certain extent be corrected if the duties of observation are given to a second man carried on a rear seat, or on a side car.

I can conceive of the use of complete troop units mounted on motorcycles in a manner similar to that in which the bicycle companies

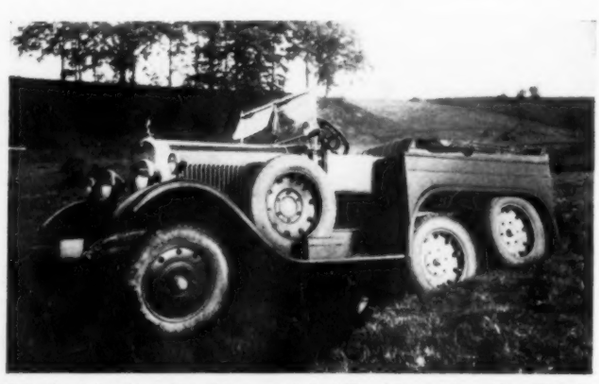


Fig. 2. The German Commercial Adler Passenger Car Chasis Equipped with Bucket Seats and Oversized Balloon Tires.

*Office of the Chief of the Motor Transport Troops, German Defense Ministry. Major, German Army. This article, written especially for ARMY ORDNANCE, was translated by Maj. H. H. Zornig, Ord. Dept., U. S. A., Assistant Military Attaché, American Embassy, Berlin.

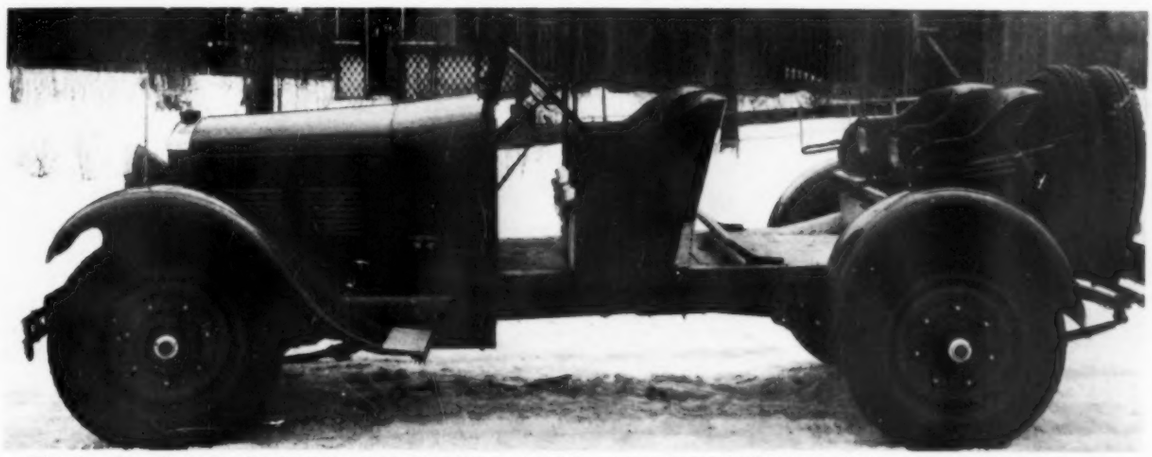


Fig. 3. The German Commercial Mercedes-Benz Passenger Car Chasis Modified by Adding a Second Driven Rear Axle and Equipped with a Special Body.

which in the early period of the World War, while the armies were still in motion, were used to such good effect. The employment of such motorcycle troops will be very similar to the employment of cavalry. Naturally the motorcycle troop is much more tied to the roads and in case of a surprise attack by the enemy is much more vulnerable. On the other hand the motorcycle troop moves faster than the cavalry and can cover much more ground in a day's work.

What will such a motorcycle troop look like and how will it be put into fight?

Each motorcycle will carry a driver and one passenger. Both will be equipped with a rifle slung over their backs. Further light machine guns, and probably also heavy machine guns, will be carried on sidecars or on small two-wheeled trailers. The ammunition will be similarly transported. Two-wheeled trailers of this kind are already being produced by several factories for carrying collapsible paddle boats and the like. The motorcycles can be driven efficiently with these trailers and side cars and get along very well even on bad roads.

In such units both the driver and his companion, or the latter alone, depending upon the situation may be put into the fight. Here the same rules will apply as apply in the cavalry when it fights dismounted.

What missions can properly be given to such motorcycle units?

The tactics of such troops must center around their great mobility, and this consideration points to their use for: holding or closing of sectians of the terrain; occupation of important points to the front and to the flanks of the advance; delaying action; rear-guard action and pursuit.

I am aware that my arguments for a motorcycle unit can be attacked in many ways and that through these theoretical proposals the problem is not solved. I would like however to point out that my proposals regarding the possibility of making use of the motorcycle are based on the consideration that in time of war one should not fail to make use of a machine, many thousands of which are today available and whose operation practically every second young man understands.

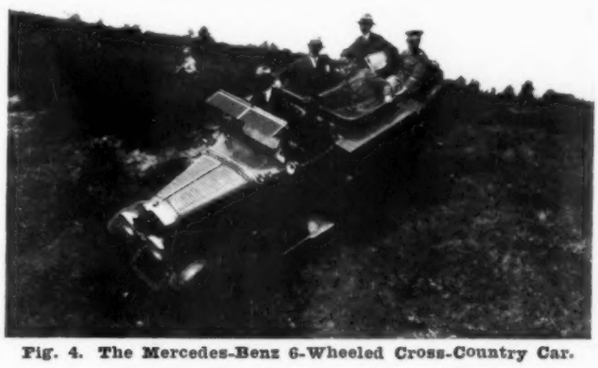


Fig. 4. The Mercedes-Benz 6-Wheeled Cross-Country Car.

THE PASSENGER AUTOMOBILE. Here also the use of this vehicle for military transport on the roads need not be discussed.

It is, however, of great importance that there be available for military use, passenger-carrying motor vehicles which are capable of making good progress on bad roads and across country. Such vehicles are not now in commercial production for in peace time motor vehicles are in general used only on good roads.

In what way then can one increase materially the cross-country performance of the normal passenger automobile?

Two methods which may lead to good results present themselves:

a. The chassis of the normal automobile may be equipped with a very light body consisting essentially of four light seats made of aluminium. With vehicles made in this way good results have already been obtained. Fig. 2 shows such a construction.

b. The other solution, which is not so simple or cheap, is the alteration of the normal chassis having two axles to one having three axles, both the rear axles being driven. As many as possible of the parts used in such an alteration should be those which are already in use in the regular commercial design, as the first thought must be to keep to as small a number as possible the special parts which are not used in normal vehicles. A vehicle of this type which has given very good results is shown in Fig. 3.

This six-wheeled passenger-carrying vehicle has excellent cross-country ability, naturally much greater than is possessed by the one with the light body which has been mentioned previously. A further advantage of such vehicles is their greater load-carrying ability

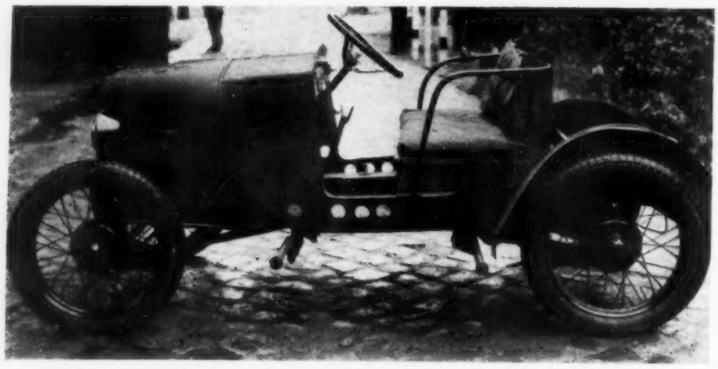


Fig. 5. The German Commercial Dixi Chassis with Special Body.

which increases their range of usefulness beyond the carrying of passengers only.

Also I believe that it will be possible quite easily to place a light armored body upon the chassis of a heavier passenger automobile and thus adapt it for use in reconnoissance. An example of such a design is the American medium armored car in which the chassis of the La Salle automobile is used.

While such a light armored reconnoissance car cannot be called a modern armored car, as one may picture it ideally, it is possible to produce such a militiary vehicle in large numbers in a short time and at moderate cost. Even large armies will not have at their disposal the desired numbers of modern armored cars, and therefore an emergency vehicle will have to be sought by everyone.: A German proverb goes: "The sparrow in the hand is better than the pigeon on the roof."

I would still like to mention the small Dixi automobile (Fig. 5) which is related to the English Austin. This small wagon with its four cylinder midget motor has excellent cross-country ability and is certainly adapted for reconnoissance work.

According to the English literature the small Austin car is at this time being used by the English cavalry in an experimental way. It appears that the attempt has been made to adapt this commercial English car in a particularly practical way for army use through slight alterations in the chassis and the application of a special body.

The Motor Truck. The great military significance of the motor truck for the supply service of an army need not be discussed. For this purpose the great number of vehicles which are in use in the industry are in every way suitable for military purposes.

It will also not be necessary to discuss further the use of motor trucks for the transportation of troops. The great importance of the motor transport organization for increasing the strategic mobility of the larger bodies of troops, especially as it effects the moving of the army reserves, is well established. It is still, however, a debated question whether larger bodies of troops, such for instance as a division, when loaded on motor trucks, even under favorable conditions, can operate on the flanks of the main front or on the flank or in the rear of an enemy.

Certainly armored mechanized fighting forces are adapted for such operations, but what army has at its disposal a great enough number of such vehicles to produce a fighting force of this kind of worth while strength.

It may be possible that under favorable conditions motor transport units carrying a larger body of troops can be used to advantage in open terrain. Such favorable conditions might present themselves under the following circumstances.

a. Situation of the enemy which would probably prevent a strong resistance, especially the appearance of enemy armored forces. Such a situation might exist for instance when a division loaded on a motor transport group is put in pursuit of a retreating army.

b. When a well developed road net is available so that the movement can be carried out in three columns on three parallel roads. A reinforced infantry regiment then marching on each of the roads will occupy a length of 40 kilometers. If we consider that these columns will march with a speed of 15 km. per hour they will march through their own length in three hours. A division marching on foot which has a length of about 30 km., marching at the rate of 5 km. an hour, requires 6 hours to march its own length.

I believe that such a calculation must always be made the

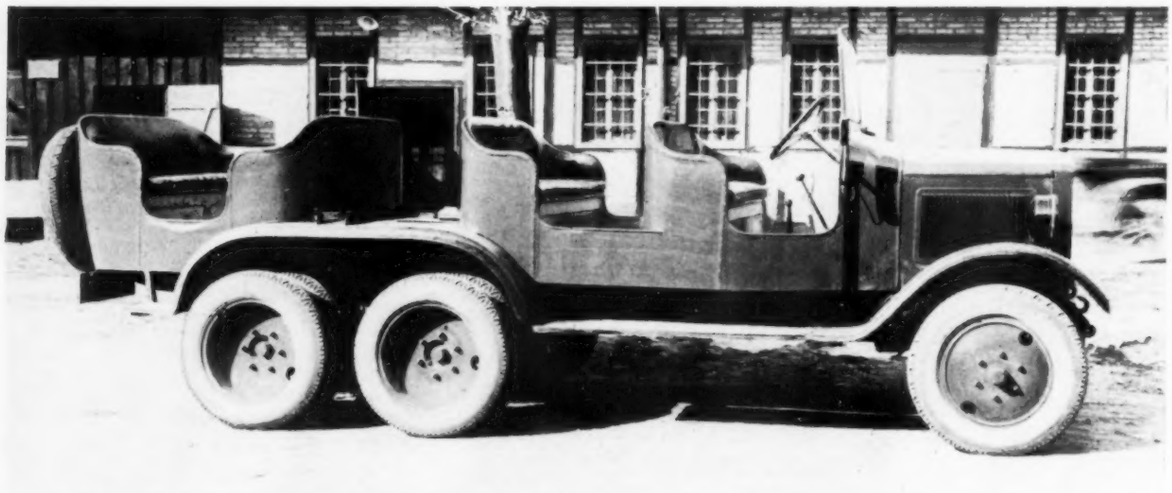


Fig. 7. The German N. A. G. Six-Wheeled Truck Chassis With Special Body for Carrying Personnel and Equipment.

basis when the length of column of troops marching on foot and being carried on motor transportation are being compared.

c. When the terrain favors the advance of motor transport units. Such conditions will exist primarily if the march is protected on one or both sides by strong features, which eliminate the probability of attack and surprise on the flanks.

Naturally it is necessary when troops, which are being carried on motor transportation, are moved forward across open country against an enemy, that suitable provision be made for reconnoissance and security. For this purpose armored cars may be used for the greater part. They must, however, be accompanied by certain other fighting units such as motorcycle detachments, infantry in light armored transport vehicles, artillery with self-propelled mounts and antitank and antiaircraft guns.

I would now like especially to call attention to the so-called light delivery trucks, of 1½ to 2-tons capacity, which are continually coming more and more into commercial use. The importance of these vehicles for military purposes must, in my opinion, not be under-estimated, as they are very fast and can make good progress on bad roads. I believe, special attention is merited by the light auto truck with three axles of which both rear ones are driven, as it has unquestionably a very high cross-country efficiency. Such chassis, equipped with the greatest variety of bodies, will be found useful for many military purposes. In the first place they are adapted as light passenger vehicles for the transport of the personnel of light and heavy machine gun groups. Similar vehicles are already being used by the police of various countries. The Morris car which has been adopted in the English Army is an example of this type of vehicle. A limited protection against small arms bullets can be secured by placing very light armor along the sides and around the machinery. The vehicle protected in this manner can be used quite close behind the front lines.

Equipped with other bodies these six-wheeled cross-country chassis will be found useful by the artillery for the carrying of ammunition and observation apparatus, by the signal troops as telephone and radio wagons, by the sanitary service as ambulances and for many other purposes.

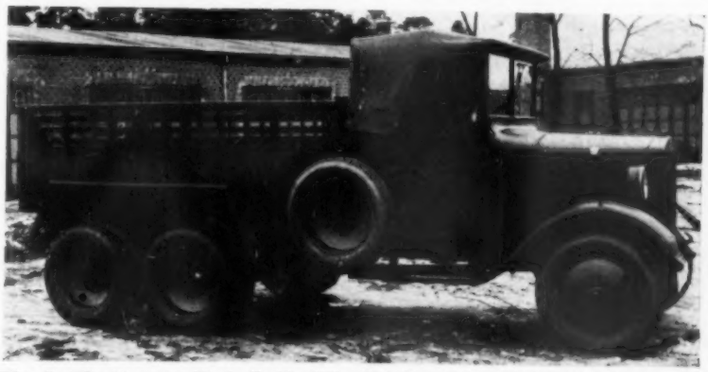


Fig. 6. The German N. A. G. Six-Wheeled Truck Chassis With Cargo Body.

The cross-country ability of such vehicles can be increased still further if a track can be developed which can be placed over the two rear wheels in the manner of the "caterpillar track." Such a construction has already been developed by the British for the Morris car.

TRACTORS. Here we come to the vehicle which is destined in the future to replace the horse in industry and on the battle field, and which already has been rightly called the iron horse. We must first differentiate these vehicles according to those which run on wheels and those which run on tracks. From the military standpoint the advantages of these machines are as clear as daylight. The wheeled vehicle is fast and cheaper to operate but of limited cross-country mobility. The track-laying vehicle is slower, very much more expensive to produce and operate, but has a very much greater cross-country mobility.

All military states have a very great interest in seeing tractors come into general use in industry, and in some this interest is so great that the trade in this machine is subsidized by the government. In general, it can probably be said that the introduction of the wheel tractor is progressing comparatively rapidly. In industry and in agriculture, on the street and in the field, this "iron horse" is seen in increasing numbers. The introduction of the tractor has so far progressed to a much more limited extent. Sometimes it uses exceptionally large amounts of fuel, damages improved roads, and the wear on its own parts, especially the tracks, is very high. All attempts to construct tracks of metal or rubber which are more durable have so far not been crowned with outstanding success. Nevertheless one must be clear that the caterpillar tractor is of great military importance for pulling heavy loads, especially such as the heavy and heaviest artillery, off of the roads.

The most important use to which tractors will be put in modern armies is that of pulling the guns for the artillery. An ideal solution would be a tractor which on the road would have a high speed (on wheels) and which off the roads could pull its load with greater certainty (track-laying). Such a combination vehicle is as yet unknown in the industry and it would be so difficult and expensive to produce that its introduction for the present seems an impossibility.

Therefore, here also we must seek the most favorable improvised solution. The numerous

Fig. 8. The German Commercial Maffai Combined Wheel and Track-laying Tractor Chassis with Special Body for Carrying a Gun Squad or Ammunition.

wheeled tractors will always be able to accomplish their mission on roads, but in heavy cross-country terrain they will not be able to handle their load. We see how the former has secured a greater drawbar pull from these machines in the fields by attaching grippers to the wheels. It is a problem for the automotive engineer to find a solution which will permit a rapid change of the wheels, or a rapid application of the grippers. Many creditable improvements have already been made in this direction.

An especially good solution of the problem of increasing the cross-country mobility of wheeled tractors seems to me to be possible through the provision of auxiliary wheels.

Fig. 8 shows a wheeled tractor on which the designer has made this provision, thus making it possible to use a track over the rear wheel and the auxiliary wheel. In this simple way the ability of the machine to negotiate heavy terrain is noticeably raised.

A further difficulty appears when artillery carriages, which are designed to be horse-drawn, are attached to tractors. Such carriages, without springs and without elastic tires, suffer badly when attached to a tractor moving over the road at 60 km. an hour. It seems therefore to be desirable to transport such carriages on trailers suspended on springs. As soon as the tractor leaves the road the carriage should be removed from the trailer and be pulled across country on its own wheels.

Fundamentally, I am in agreement with the view that from the military standpoint as from the commercial, the wheeled tractor is to be preferred to the track machine.

The radius of action and the life will always be less for the track vehicle than in the case of the wheeled tractor. Another great disadvantage is that in the use of tractors for military purposes, it will always be necessary to provide a special transport vehicle to carry it when moving on the road. This, as we see from the article by General Williams, has been found to be necessary in the case of the American light tank T1 E1, notwithstanding the excellent performance it has shown in its endurance tests.

In closing, I would like to propose for consideration the possibility of eliminating the track vehicle altogether by developing the multiple wheeled vehicle so that on the road it will have the speed which its wheels inherently give it, and off the road will be fully equal to the track-laying type.

Active Duty Training Courses for Ordnance Reserve Officers

TRAINING courses for reserve officers will be conducted at the Watervliet, Watertown, Springfield, Frankford, Picatinny and Benicia arsenals from May 11th to May 24th.

The course at each arsenal will be of the same character as has been given during the past few years. It will be particularly appropriate for officers assigned to the respective arsenals and for officers assigned to the various district offices whose duties require a knowledge of the inspection or manufacture of any of the matériel which is manufactured at the arsenal.

Training courses, similar to those described above, will be conducted from July 6th to July 19th, at the Frankford, Picatinny and Watertown Arsenals. Both basic and advanced training courses will be conducted at Rock Island Arsenal from July 6th to July 19th, and at Aberdeen Proving Ground from July 27th to August 9th, 1930. The basic course will be applicable to all officers, irrespective of their assignment. The advanced course will be applicable only to officers assigned to Rock Island Arsenal or Aberdeen Proving Ground, and to those who require special knowledge which can best be imparted to them at either of these establishments. Officers whose duties will require knowledge of the manufacture or inspection of matériel will not, under ordinary circumstances, be sent to take the advanced course at Aberdeen Proving Ground as a course at an appropriate manufacturing arsenal is much better adapted to their needs. Only a limited amount of personal instruction can be given advanced students at Rock Island Arsenal and Aberdeen Proving Ground, and officers will not be considered who are not capable of securing satisfactory training largely by their own efforts. In general, no officer who has not completed either the basic course or an R. O. T. C. training camp at Aberdeen Proving Ground will be recommended for advanced training at Rock Island Arsenal or Aberdeen Proving Ground, and no officer will be ordered to take the basic course a second time. R. O. T. C. graduates who have attended camp at Aberdeen Proving Ground will be given ordinarily further training elsewhere, but R. O. T. C. graduates who have not been trained at Aberdeen will be encouraged to attend the basic camp at Rock Island Arsenal or Aberdeen Proving Ground if within a reasonable distance. In considering an officer for an advanced course special consideration will be given to the character of advanced training which can appropriately be given at Aberdeen. Training in the following subjects will be given this year: aircraft armament, artillery ammunition and bombs, fire control, mobile artillery, Field Service organization and activities, automotive matériel, ballistics, small arms and small arms ammunition, seacoast and railway artillery and antiaircraft artillery.

It is the desire of the Office of the Chief of Ordnance to take favorable action with regard to all applications which are received, but it is essential that each application shall have been thoroughly considered by the officer's place of assignment. Funds for training are limited and it is essential that each officer be given only that training which will be of value to him in his assignment. It is desired to give each officer sufficient background to enable him to function efficiently in his assignment, but no attempt can be made to give him such training as will tend to make him expert in the performance of duties of a widely different nature.

Priority for spring training will be given to those officers who have had the least training and who, by reason of education, training, or experience, are qualified to receive the maximum benefit from the training for which recommended. It should be kept in mind that no officer may be trained twice in the same fiscal year. It is preferable that an officer complete the basic course before being recommended for spring training, although each case will be considered on its merits.

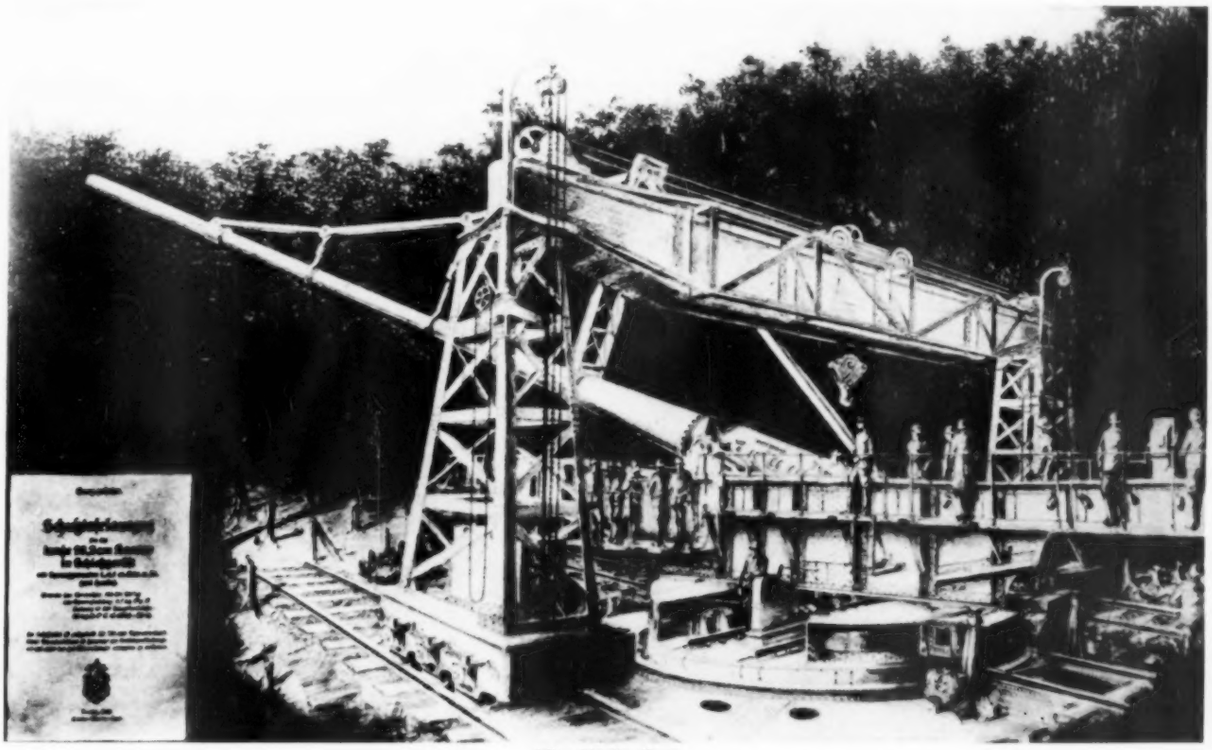
Priority for summer training will be given to those officers who are recommended for the basic course, and to those recommended for the advanced course who have had the least training and will profit by the advanced courses.

The Paris Gun

A Review of Colonel Miller's Fascinating Narrative

By Donald Armstrong*

DURING the past year there has been an astonishing vogue of books dealing with the World War. Most of these volumes have described the activities of the men behind the guns, in the trenches, in the hospitals, etc. In other words, they have been descriptions of personal experiences with the interest that naturally derives from such a fact. An even more astonishing feat has been accomplished by Lieut. Col. Henry W. Miller, Ordnance Reserve, the author of the book "The Paris Gun."[1] His narrative about a gun is as fascinating as any "best seller." True, the gun happens to be unique in the annals of warfare, but that a piece of ordnance and its ballistics could be vested with such absorbing interest to the layman never entered anyone's mind until Colonel Miller performed the successful experiment. The technical expert might wish for additional details but to the layman the amount of statistical data is ample and is admirably presented for his consumption.



The Paris Gun.

A Drawing Prepared by Colonel Miller, of one of the "Mystery Guns" Which Shelled the French Capital in 1918.

Colonel Miller describes the four separate bombardments of Paris from the point of view, first of the effect in the city, the geographical distribution of the hits, and their material and moral effect. Then he describes in remarkable detail the operations from the German side, first explaining the mount and gun, the powder charge and the projectile, then the orientation and ballistic computations in the field and, finally, the loading and firing. Everywhere is evident the results of a most painstaking and effective investigation of an unusually well-guarded military secret. The author's success in finding sources of information so reliable and accurate is most noteworthy. He is to be congratulated on his efficient service of information.

AS a matter of fact, if personal reminiscence may be pardoned, there were reasons before reading this book to believe that Colonel Miller's description of the gun might be erroneous. Some years ago, the writer had learned from rather reliable sources abroad an entirely different conception of this gun. This was submitted to the War Department at the time with some reservations as to its reliability and it is now believed that Colonel Miller's information effectively disposes of this particular theory. Nevertheless, it is of interest since the information obtained at that time was to the effect that the German long-range gun was a "multi-charge" gun based on a principle with which the Ordnance Department had already experimented in 1872 and later in 1884 and 1885. My informant had stated that the Paris gun was a departure from the usual type of weapon, in that the powder charge was contained in (1) a

*Office of the Assistant Secretary of War. Major, Ordnance Department, U. S. Army.

1The Paris Gun—The Bombardment of Paris by the German Long Range Guns and the Great German Offensive of 1918. By Henry W. Miller, Lt. Col., Ord. Res. New York: Jonathan Cape and Harrison Smith. 1930.

principal charge in the usual powder chamber, and (2) a number of supplementary charges located in additional powder chambers in the breech reinforce. These supplementary powder chambers connected with the bore of the gun in front of the forcing cone and the powder in them was not ignited until the projectile had passed the ports opening into the bore. In this way the powder pressure curve was sustained at a high level during the travel of the projectile within the bore. Colonel Miller's description of the powder charge is entirely logical and explains clearly the meaning of the range table item of the weight of the charge where there is a distinction between the "weight of the entire charge" and the weight of the "front forward powder section," (Gewicht der vorderen Vorkartusche) which was a variable dependent on the degree of erosion of the bore and the range desired.

The success of the Paris gun depended on the design of projectile and, as Colonel Miller states, many months were spent in determining the final form of shell which turned out to be of the so-called "rifled" type. This was necessary because of the failure of copper and other alloy rotating bands to withstand the firing stresses at the high velocities and pressures used. It would seem only fair to give credit to the experiments made in France by General Charbonnier, Inspector General of Naval Artillery, with this type of projectile before the Paris gun fired a shot. General Charbonnier had decided that the problem of erosion in high-powered guns necessitated some solution other than the ordinary copper rotating band provided for the usual projectile. He further realized that for very high velocities and pressures copper rotating bands would be absolutely inadequate. Therefore, during the war he started experiments with rifled projectiles at Gavre where considerable progress was made in the design of projectiles with rifling on the exterior of the wall fired from guns of existing types. A decision had just been reached to design a special gun to fire projectiles of this type when the first rifled projectiles of the Paris gun fell not very far from General Charbonnier's office where a model of his own rifled projectile was located.

PERHAPS a detailed description of the projectile would be out of place in a book of this character, but it is one of the most interesting phases of the whole subject to an artilleryman or ordnance expert. The projectile was provided with a false ogive to reduce air resistance, but curiously enough the base of the shell was cylindrical (at least in the case of the 21-cm. caliber) instead of being streamlined. Ordinarily, German practice avoided the streamlined base, although the latest types of 77-mm. and 105-mm. at the end of the war finally utilized this device to increase range. The false ogive of the 21-cm. projectile had the unusual radius of ogive of 11 calibers, and was approximately 2.3 calibers long. The projectiles had two copper rotating bands in addition to the rifling machined on the walls. There were 64 grooves of rifling, the twist of which was 4 degrees. The composition of the steel from which the shell was made was nickel-chrome with about 2.1 percent nickle and 1.4 percent chrome content. As far as is known, there was no failure of any shell fired from these guns to explode.

Colonel Miller's book may be mildly criticized for a few errors. Ludendorff's name is incorrectly spelled throughout except in one place and there are a number of other instances of misspelled proper names. On page 186, there is an error where it is stated that the weight of the projectile was increased from 120 to 124 kgs. This should read from 104 to 124 kgs. On page 88, the author states that the correction for curvature of the earth was "something unique" in field artillery firing and further expresses surprise concerning the correction for the rotation of the earth. As a matter of fact, these corrections have been applied in our own Coast Artillery for many years and such corrections were always made for long-range firing at the front.

Outside of the noteworthy technical achievement of designing, manufacturing, and successful firing of these monster guns, the conclusion must be reached that the effort involved can hardly be justified by the results obtained. The projectiles were peculiarly ineffective with the exception of one that hit the roof of a church, and the exodus of Parisians must be attributed much more to bombing raids by aircraft, and the successful advance of the German Army in the spring of 1918 than to fear of the Paris guns. Nothing in the book can alter the dictum of the Westervelt Board that "such guns have no military value and their construction is not justifiable."

The first and second series of firings on Paris were carried out from the Crépy position which was only ten kilometers from the front line, and hence well within counter-battery range of heavy French guns. The remarkable work of the French service of information agencies in determining the exact position of the three emplacements four days after the firing commenced is a great tribute to the value of this service.

For the information of the technical reader, there is appended hereto in tabular form certain data concerning the two calibers of guns that fired on Paris, most of which is included in Colonel Miller's book. Particular attention is invited to the small high explosive charge contained in the shells, a condition created by the necessity of having a particularly thick base and walls for a projectile fired at such high velocities.

BALLISTIC DATA OF PARIS GUNS

	21 cm. guns	23.2 cm. guns
Weight of projectile (kgs.)	104 to 106	124 to 126
Length in calibers	4.5	4.1
Weight of high explosive charge (kgs.)	6.85	8.7
Maximum range (kms.)	128	114
Powder charge for Maximum range (kgs.)	167	196.5
Elevation (constant)	50°	50°
Muzzle velocity (m.s.)	1646	1648
Time of flight (secs.)	182	182.1
Remaining velocity (m.s.)	763	764

Colonel Miller's thesis that the Paris guns were an important part of the German offensive commencing in March, 1918, leads him to devote a large portion of the book to the operations of the field armies in order to present a complete picture of events. Reproductions of numerous photographs and maps add greatly to the effectiveness of the text. It is certain that there exists nowhere an account so complete and accurate of this unique weapon as is found in this book. Colonel Miller's work is an outstanding contribution to ordnance literature, the value of which is not diminished by its presentation in popular form.

The Hoover War Library

The Great International Archives At Stanford University

By Ralph H. Lutz*

THE Hoover War Library of Stanford University is today the greatest library center for the study of the World War and the reconstruction of Europe since the Armistice. The facilities it offers for research in the field of history as well as the other social sciences are duplicated nowhere in the world. One might indeed presume that any great international library whose works have to do with the World War would be centered somewhere in Europe, among those countries whose soldiers, statesmen and propagandists are now giving up valuable private papers and documents in order that future generations may know some of the impelling motives and basic truths of the war period. There are, of course, many libraries on the war to be found in Europe. Certainly the *Bibliothèque et Musée de la Guerre* at the *Château de Vincennes* near Paris and the *Weltkriegsbucherei* at *Schloss Rosenstein* near Stuttgart present extremely valuable collections. Other than these two there is no library dealing with the recent war period as complete as the Hoover War Library.

A summary of the materials in this library from all nations—whether belligerent or neutral—reveals the vast extent of this workshop which is destined to become within a few years the chief point of historical research on the World War. There are in the Hoover War Library over one million single letters and documents in the nineteen archive collections. The manuscripts, in addition to the archive collections, number 21,050. The extent of the book and pamphlet collection is shown by the following figures for works in English, German, French, Russian, Italian, Hungarian and other languages: 42,000 books; 135,500 pamphlets. There are 375 files of important newspapers for the period 1914 to date, while the titles of war periodicals and trench papers number 7,775. In the group of rare collections of war materials are over 20,350 posters, proclamations and watercolors. The library also contains a collection of 3,030 military and naval maps.

AS early as 1914, Herbert Hoover, then Chairman of the Commission for Relief in Belgium, recognized the importance of preserving the important records of that great philanthropic organization and gathering about them a great library on the World War. In February, 1915, Professor E. D. Adams wrote to Mr. Hoover, then in the occupied territory of Belgium and France feeding the starving civil population, that "at least the private and confidential letters in regard to the work might well be sealed up and kept at Stanford University." To this Mr. Hoover replied that he considered "the suggestion of extreme value and I will see to it that every atom of material is preserved which it has been from the beginning." Later as American Food Administrator and head of the Supreme Economic Council, Mr. Hoover was able to obtain from the belligerent and neutral nations a vast amount of original papers. Shortly after the Armistice he cabled President Wilbur of Stanford University that "a fund was available for an historical collection on the Great War if a suitable commission was at once organized and sent to Paris to undertake the work." For this task President Wilbur commissioned Dr. E. D. Adams who proceeded to the scene of the peace conference and organized that great undertaking which resulted in the establishment of the Hoover War Library. Dr. Adams was assisted in this task by several young American scholars, including myself, who were all members of the American Expeditionary Forces.

With the financial and material aid of Mr. Hoover, the library grew in five years to first rank in historical equipment. During the time that Mr. Hoover was head of the Russian famine relief, Dr. Frank A. Golder was able to gather and send to Stanford a great collection dealing with

Foreword

THE average individual usually fails to appreciate the historical significance of events and conditions while they are in the making. In keeping with this lack of historical appreciation, there is negligence, as a rule, in the contemporaneous collection of historical material bearing upon the rapidly forming events and conditions. Outstanding as an exception to man's usual tardy collection of historical materials is the Hoover War Library. Here is a library visualized by Mr. Hoover and collected contemporaneously by an able and extensive organization selected for the purpose.

The contents of the Library are of great value to the student of the economic, social, financial, political, and military history of that critical period in the world's progress when the structures of our civilization were in the balance.

Recognizing the value of this remarkable collection of material for the work of the Historical Section of The Army War College, arrangements have been completed with Dr. Lutz to survey and catalogue the documents from the viewpoint of military history and the participation of the United States in the war and in the activities of the post-war period.

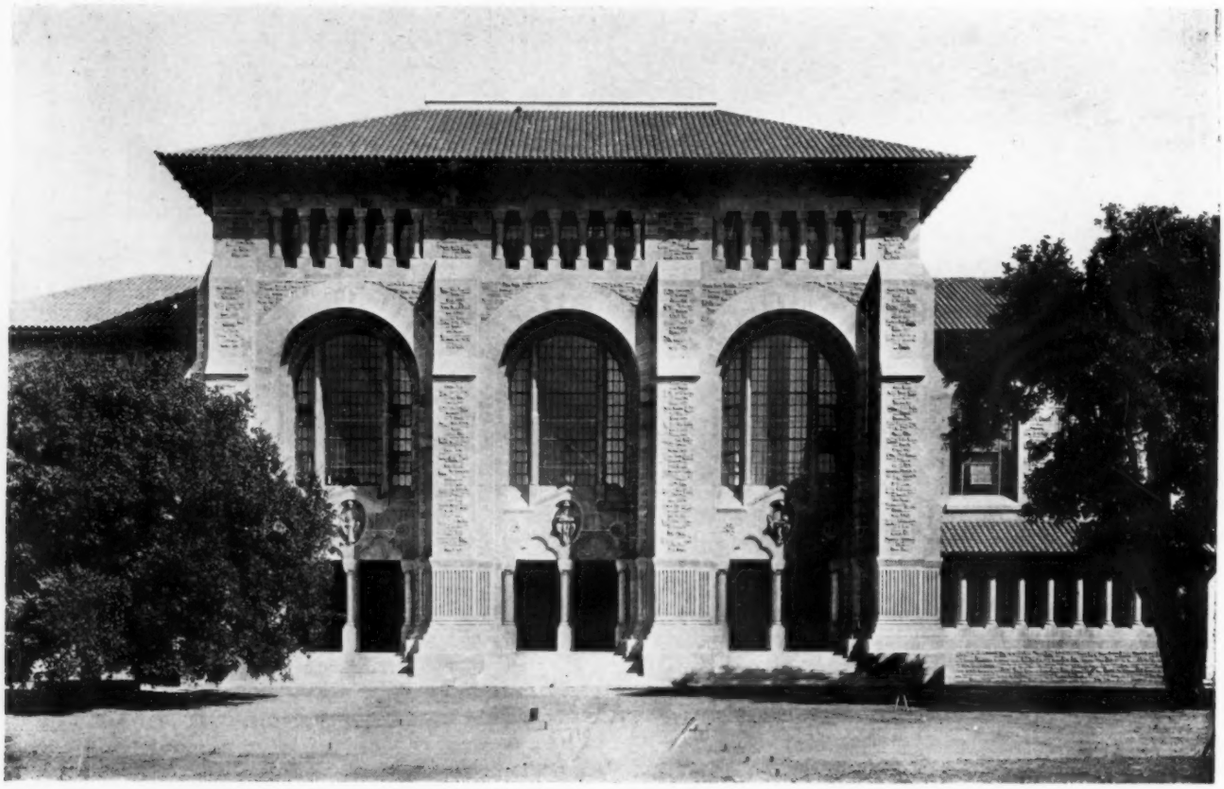
Already some progress has been made in the practical accomplishment of this task. To make this great collection widely available for research, the Historical Section furnishes copies of catalogue cards to the Librarian of Congress.

If the student, writer or investigator of recent military history intends to cover completely his chosen subject, it is necessary for him to include the rare documents of the Hoover War Library in his field of work.

In giving to the military public through the columns of ARMY ORDNANCE *a brief survey of the library, Dr. Lutz is performing a valuable service for the Government, the library, and the ever increasing body of earnest students of history.*

COL. C. S. VESTAL, C. A. C., U. S. A.
Chief, Historical Section,
Army War College.

*Chairman of Directors, Hoover War Library and Professor of History, Stanford University.



Front View of the Library at Stanford University.

Bolshevism and the establishment of the Soviet government in Russia. The acquisition of another great collection on the reorganization of Germany gave a most convincing illustration of the ability of American scholars to overcome the material obstacles to research in European fields. In 1924 Mr. Hoover gave the library a permanent endowment which is now administered by a board of directors.

Through the various delegations to the Paris Peace Conference and afterward by contact with their respective foreign offices, Professor Adams was able to secure excellent collections of delegation propaganda as well as government documents for the period of 1914-1919 from forty-seven European, American and Asiatic governments. The principal Allied Powers, the lesser states of the Entente, as well as the neutral Powers, were quick to respond to the request for historical documents. However, it was not until November, 1922, that the representatives of the Italian Government informed us that over half a ton of documents had been shipped from Rome to Stanford University. Even this long-delayed collection was destroyed at sea by fire, but was generously duplicated by Italy. In many instances duplication would have been impossible, particularly in other classes of material; and it always is difficult, even in governmental documents, for obvious reasons.

THE collecting of these government documents began during the sessions of the Peace Conference from Professor Adams' office on Avenue Montaigne. Delegations from every nation were then in the city; for months they had devoted themselves assiduously to drawing up memoranda for the conference and preparing propaganda for the public. Here was indeed a harvest ready for reaping. Professor Adams called upon all the delegations, obtained in many instances copies of everything they were using at the conference, and enlisted their aid in securing further gifts of government publications from the states they represented. There were many delegations from unrecognized states present in Paris such as Carpatho-Russia, Fiume, Korea, Ukraine and Azerbaidjan. They had come from the backwoods and borderlands of eastern Europe and Asia to present impossible claims on behalf of unknown or impotent peoples. For example, a delegation from "Pontus on the Euxine Sea," the old kingdom of Mithradates the Great, which Julius Caesar crushed in 47 B. C., was asking the peace conference to re-establish this state after a lapse of two thousand years. The documents from these delegations were also collected with great care, although the delegates themselves were often hard to locate. But whenever they were found they proved anxious to talk of their problems, their claims and their hopes, and to present to the historian a case to which statesmen would pay no attention. The head of the Egyptian delegation who occupied a room at the top of a long dark flight of stairs in an hotel off the Boulevard San Michel said to a representative of the Hoover War Library: "You must know, Monsieur, that we in Egypt know how to value historians. We have saved documents for six thousand years."

A great many society publications were also secured by Professor Adams while he was in Paris and London as a result of personal requests and not a few came in unsolicited. It once happened that while Professor Adams was walking near Piccadilly Circus a stranger slipped a package into his hand and hurried away. The package contained prohibited literature published by a certain well

known pacifist organization which had fought against conscription until suppressed by the police.

The manuscript division of the library has as its nucleus a number of confidential reports, also secured in 1919, bearing on conditions in Europe during the war. There are also copies of the private papers of men who have been in a position to feel the pulse of things. Many of these personal memorabilia can not now be described since they have been locked away for a term of years in compliance with the donor's restrictions.

The Hoover War Library—Four Truck Loads of Documents as Received from Europe. (Right, Prof. E. D. Adams; left, Prof. R. H. Lutz).

The number of Russian manuscripts in the library indicates the richness of this almost unexploited field. The Russian collection is the result of three years of field work by Dr. Frank A. Golder. During 1920 Dr. Golder, unable to cross the frontier into Russia, travelled up and down Europe, and got into touch with all groups of Russians living in exile. Then in 1921 he was able to enter Russia itself. Just at that time the new economic policy went into effect, so that the buying and selling of books became lawful for the first time in several years. The rouble was then almost worthless, but the price of books had not yet risen, consequently Dr. Golder was able to purchase books at prices, which in Western money, were a mere fraction of their value. The story is told of a communist who was living in a house which once had belonged to a lawyer, and using the lawyer's library for fuel. Dr. Golder heard of these books and sent word that he would buy them. "Perhaps the professor will give me a box of food for them?" the communist suggested, and the bargain was closed. The books were immediately removed to a place of safety. Next day the communist appeared and asked for Professor Golder.

"I have made a mistake," he said. "I must have two boxes of food."

"Very well," the professor answered, "but this thing stops right here."

As a result of my collecting work in Hungary immediately after the fall of the Soviet government, two large packing-cases full of Bolshevik materials were gathered for the library. These contained pamphlets, posters, records of Soviet meetings and decisions, and copies of lectures delivered at the "Communist School for Agitators." Later the White police in their eagerness to destroy all traces of the Red régime demanded that these documents be burnt, and the intervention of the American officers in Budapest and the protection of an armed guard were required to save them. In consequence of the hasty action of the Budapest police, the Hungarian National Archives now lack certain records which can only be found at Stanford University.

AMONG the important groups of materials in the Hoover War Library are the following: government documents, publications of organizations having no governmental connections, serials, books and pamphlets, newspapers, personal memorabilia and diaries, special collections. The collection of government documents is divided into three divisions: national and provincial or state documents, municipal and county documents, publications of national and international organizations having governmental connections. The files of legislative debates and accompanying documents are practically complete for all countries, whether belligerent or neutral, from 1914 to date. The Russian documentary collection contains the Duma debates, journal of the council of ministers, the bulletins of the central executive committee and the bulletins of the congresses of the soviets of the U. S. S. R. The Austrian collection contains the minutes of the proceedings of the council of the empire from 1908 to 1914. The files of official gazettes or journals are complete for all countries, including all colonies and countries held as mandates under the League of Nations. Among our rare sets, we have a complete file of the Saloniki Gazette, 1916-1917, published by Venezelos at Saloniki and a complete file of the Serbian *Srpske Novine*, 1916-1918, published on the island of Curfu. The files of *Bulletins des lois* or their equivalent are complete for all countries from 1914 to date. Included are also collections of emergency war legislation and collections of administrative laws of mandates and colonies. The publications of governmental ministries and national banks are practically all represented in the library. Included in this subdivision are war-time bodies dealing with problems of food, shipping, fuel, munitions, reconstruction, national service, war labor and war propaganda as well as temporary committees and commissions appointed to investigate special war problems. Among the latter are *The Inquiry*, established by President Wilson to facilitate the work of the peace conference, and governmental spy reports on conditions in enemy countries such as the British reports on economic conditions in Germany and Austria, 1914-1919. Our collections of the publications of the food administrations of Great Britain, Germany, and the United States are unusually complete. We also have a remarkably extensive collection of war propaganda materials, that

for Great Britain being the most voluminous. This collection contains a large portion of the publications of the Ministry of Information library and of Wellington House, a department of the Foreign Office. In addition to the war propaganda, the library has a collection of over two thousand pieces of propaganda presented to the peace conference by the delegations at Paris. The library's large collection of election and administrative posters and proclamations is most extensive for the German, Austrian and Russian revolutions, and for the Schleswig, Eastern Galician and Upper Silesian questions.

The second division, consisting of municipal and county documents, contains a complete set of London county council documents, 1914-1919, and less complete but extensive sets for Berlin, Paris, Stockholm, Belfast, Danzig, Brussels, and the occupied cities in northern France, Poland and Roumania.

The third division, consisting of publications of national and international organizations having governmental connections, includes the important national and imperial conferences dealing with war and reconstruction problems such as the first and second Industrial Conference at Washington, the publications of interallied bodies of the war and post-war periods, such as the Supreme Economic Council and the Allied Maritime Transport Council, the publications of the Paris peace conference, and the publications of the commissions set up by the treaty of Versailles such as the International Commission for Schleswig, the Saar Basin Governing Commission, the Reparations Commission and the Interallied Rhineland High Commission. Especially complete are the publications of the League of Nations, the International Labor Office and the Permanent Court of International Justice. The library also has a carefully gathered collection of documents pertaining to the Washington Conference. This entire group of government documents consists of materials from over fifty-five countries, provinces and cities. The majority of these reports are published, certain ones are printed but not published and others are in manuscript form, often confidential or secret.

THE second group of materials consists of publications of organizations having no governmental connections. First in importance are the publications of national and international conferences and congresses dealing with the economic, social and political aspects of the war and post-war periods such as The Institute of Pacific Relations, 1925-1927. The publications of important political parties are especially complete for Great Britain, France, Germany, Austria, and Ireland. The publications of Chambers of Commerce include those of the continental states and the dominions and colonies of the British Commonwealth of Nations. The publications of other miscellaneous organizations and societies includes the principal publications for the war period of over six hundred societies in the belligerent and neutral states. These societies were concerned with social, economic and political problems such as population, temperance, social hygiene, emigration, tariff, labor, tax reform, civic improvement, peace, league of nations, unemployment, education and housing. Since these organizations influenced public opinion in the various countries, their pamphlets and periodicals are valuable for a study of the effects of the war upon national life. In the library are also certain secret publications of organizations which were suppressed by the war governments of Germany, Austria, France and Great Britain.

The serial group contains files of periodicals dealing with economic, political and social phases of the war and reconstruction periods, and is fairly complete for all countries and languages. For the war period the collection is comprehensive and includes sets of ephemeral war serials, many of them being the organs of purely war-time bodies. For the reconstruction period, the collection is a selected

The Hoover War Library—A Section of the Library Showing Permanent Arrangement of Documents in Fire Proof Stacks Accessible for Research.

one, and one hundred seventy-five of the periodicals represented in this collection are received currently. Twenty-two of the latter are Russian. The extent of our serial collection is shown by the following figures: 2,600 titles in German, 1,400 titles in English, 1,200 titles in Russian, 1,100 titles in French, and 1,200 titles in other languages.

THE library has a selected collection of books and pamphlets of all countries and in all languages dealing with the social, economic and political aspects of the war and reconstruction. It contains materials on the economic and social phases of such problems as food, agriculture, commerce and manufactures, marine insurance, banking practices, inflation and suspension of specie payments, improvised emergency currencies, restrictions on foreign commitments, utilization of private holdings by government agencies, reparations, interallied debts, transportation, immigration and population. Among the political and military subjects are causes of the war, war responsibility, propaganda, the unified command, the mandatory powers, conduct of foreign relations during the war, Latin-America and the war, development of international administration

since the war, minorities under the League of Nations, political parties, the revolutions of 1917-1920, war and post-war nationalism, disarmament, the peace treaties, the Fascist movement and the Bolshevist movement. The extent of this collection of printed volumes is shown by the following figures: 12,000 titles in Russian, 10,000 titles in French, 9,000 titles in English, 8,000 titles in German, 1,500 titles in Italian, 1,500 titles in Hungarian, 3,000 titles in other languages.

Newspapers are represented in the library by complete files for the war period of all important newspapers of the important countries of the world. For the less important countries the library possesses at least a government and an opposition paper. The French, German, American and Russian collections are the largest. If fragmentary sets are counted, the Russian collection totals 150 newspapers covering especially the years 1917-1918. The library's collection of trench, camp and prison camp newspapers contains complete representative files for all belligerent countries on all fronts.

The governmental press reviews are indexed and classified digests of newspapers. For France there are complete files of the daily bulletin of the foreign press and the periodical bulletin of the press. The German collection includes a complete file of the news of the foreign press and the general staff newspaper. For Great Britain there are files of the daily review of the foreign press including the various supplements.

THE group of personal memorabilia and diaries contains material placed in the vaults of the library with restrictions upon its use. In many instances the library is not permitted to announce that the materials are in its possession. The following will serve as illustrations of this group: war and post-war diaries of relief workers, the Kanner papers containing accounts of Dr. Kanner's interviews with German and Austrian statesmen, the documents of General Bermondt, the Herron papers concerning the Austrian and German peace proposals during the war, the documents of General Heroys, and the David Starr Jordan correspondence on questions of peace, internationalism and contemporary world politics.

The group of special collections contains archive materials, private papers of men who rendered important public services and special libraries. A large number of the documents and volumes in this group will not be available for public perusal for many years. The library is constantly adding to these archives through the generosity and interest of governments and through exchanges. Included in the latter material is the Commission for Relief in Belgium archive. This large archive, occupying about one-eighth of the library's shelving space, is composed of diplomatic correspondence with belligerent and neutral governments, reports of field workers, shipping, accounting and administrative records and general reports on economic conditions in Belgium and Northern France. In this group are also documents of the Near East Relief, the American Relief Administration, the American Red Cross, the United States Food Administration, and the White Russian Archives. In the Hoover War Library is now the library of Alfred Fried which comprises a comprehensive record of the peace movement from 1892 to the beginning of the post-war period.

In the field of international research the Hoover War Library stands forth as a great contribution to the research workers in social sciences. Here may be studied the social, economic and political phases of the war for all nations but especially for Russia, Germany, Austria, France, Belgium, Great Britain and the United States. Here are government documents illustrating the changes during the war in the lives of the states of the world and also a great archive of material bearing upon the problems of reconstruction after the end of hostilities. This great library of the causes, phases and tragic results of the greatest catastrophe of the modern world may be called an international archive, comparable in importance to the archives of a great state combined with a library selected by scholars for the use of scholars. The development of this library to its position of leadership is one of the significant achievements of American universities in the past decade.

Uses of the Parachute

NOT only has the parachute used in the Army Air Corps the function of saving human life but smaller editions of the standard "chute" will be used with a view to their saving expensive articles of equipment. The Air Corps has perfected and is using large gliders for target practice for antiaircraft artillery. The gliders are taken up and released from a plane in flight. Upon their release the gliders, some of them with a ten-foot span, glide to earth much the same as would an airplane, losing altitude slowly, in the meantime serving as a target at which the antiaircraft artillery may shoot. The gliders are well made and are quite expensive. Some of them have been used time after time, making their landings without injury. However, buildings, trees and steep banks have damaged many of them, some being totally destroyed on their maiden flights, even after escaping the ravages of antiaircraft fire.

To prevent such damage, all gliders will soon be fitted with small parachutes. These chutes will have a time fuze, the fuze being so set that it will operate after a definite period of time following the release of the glider from the parent plane. Upon the functioning of the fuze, a small parachute is released, which checks the forward flight of the glider and allows it to settle very slowly to earth, where it may be recovered for repeated use.

With the life-saving parachute jumps made on December 4, 1929, on the outskirts of Goodwater, Alabama, of Lieut. J. M. Gillespie, Staff Sergeants Dwight M. Capps and Richard M. Bremer, 96th Bombardment Squadron, Langley Field, Va., the number of lives saved in this country through such jumps reached exactly 200.

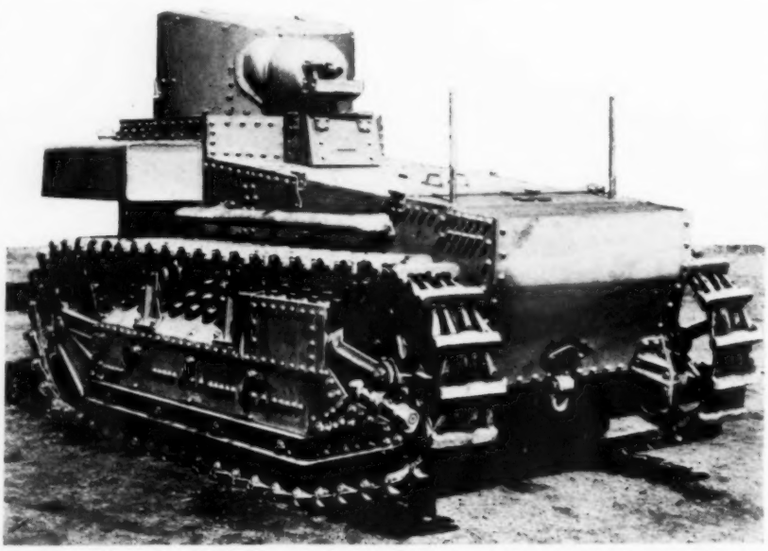
A total of 209 emergency jumps have thus far been made, there being nine occasions where members of the mythical "Caterpillar Club" made more than one jump in the extreme emergency. Col. Charles A. Lindbergh, Chief Caterpillar, is credited with four emergency jumps, and Capt. Frank O'D. Hunter, Lieut. James T. Hutchison, Lieut. E. H. Barksdale (deceased), Sergeant Fred. P. Miller, Maj. James Rutledge and Al Wilson with two each.

Mechanization and Cavalry

Can Fighting Machines Replace the Mounted Soldier?

By G. S. Patton, Jr., and C. C. Benson*

THE cavalry has been in a good many tight places during the last thousand years, but it has always managed to keep one jump ahead of its rivals. When the clothyard shafts of English bowmen mowed down the flower of French chivalry at Crecy in 1346, it appeared that horsemen had met their match. Had they been bound to the tactics previously in vogue, the cavalry might shortly have disappeared. Later the use of gunpowder threatened to drive cavalry from the field; but it adopted the despised firearms and soon regained its lost prestige. When the improvement of firearms again placed the cavalryman at a disadvantage he discarded his heavy armor and learned once more to charge in mass at speed. The cavalry of Frederick the Great and Napoleon, despite improved firearms, scored many decisive victories. The development of accurate long-range rifles, and, more recently, machine guns, has again put cavalrymen to the test of adaptability. The question is now raised, as it has been raised many times in the past, is cavalry still useful enough to justify its existence? For authoritative answers to this question, we look to the well-considered views of experienced military leaders. Here is what some of them have to say about cavalry:—General John J. Pershing.—"There is not in the world today an officer of distinction, recognized as an authority on military matters in a broad way, who does not declare with emphasis that cavalry is as important today as it has ever been."



The New, Fast Cross-Country Fighting Machine of High Strategic and Tactical Mobility Presents a Difficult Problem Not Only to Cavalry but to Practically all Other Troops as Well.

Field Marshall Sir Douglas Haig.—"Cavalry is indispensible, not only to act as mobile infantry, but to reap the fruits of victory.—Infantry and artillery can win battles; only cavalry can make them worth winning."

Marshal Foch.—"On the Western Front, cavalry especially participated in the defensive battles, where they were engaged at the most difficult moment.—The large cavalry units, thanks to their own mobility, were able to intervene in time and bring the precious assistance of their fire to the weak points of the defense."

Marshal Hindenburg.—"Cavalry will continue to be important. There were many times when I wished I had more of it."

General Ludendorf.—"The cavalry was of the greatest importance and service to me in all campaigns of movement. In the March, 1918, offensive, I felt seriously handicapped by lack of cavalry."

In offensive and defensive actions in stabilized situations, as well as in warfare of movement, modern cavalry has proven its value. One final comment, to bring the record more closely up to date, is taken from an address by General Charles P. Summerall on August 12, 1927. — "There has been a great deal of mis-information broadcast relative to the cavalry. It is a fact that cavalry is of far more importance than it has ever been."

Since these views were expressed, a new problem has arisen — what to do about fast cross-country fighting machines? This problem concerns not only the cavalry, but also the infantry, the artillery, engineers, signal troops, supply services, and air forces. The armored vehicles now being built are practically immune to air attacks; they have high strategical and tactical mobility, and can drive far into the enemy's territory to attack installations, including airdromes, that have heretofore been regarded as secure. As the cavalry is particularly charged with providing security for other forces, it naturally devolves upon the cavalry to devise ways and means to neutralize these new weapons. To bury our heads, ostrich-like, and ignore them, would be foolish. Foreign nations are proceeding with dispatch to perfect fast tanks, armored cars, self-propelled gun mounts, and their auxiliaries. More and more of their tactical thought is being centered upon the use of these machines. We may have to face them in future wars, whether we are ready or not. Indeed, past wars have had the faculty of presenting themselves without regard for the state of preparedness; they do not wait for tactical and material proficiency. All branches are vitally concerned with the problems that ground fighting machines are thrusting upon them; and so far as the cavalry is concerned, we propose to face the issue.

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CAN fighting machines replace the cavalry? Much has been written about the power of machines, and all too little about their limitations. Granting that armored caterpillar vehicles can crash through belts of barbed wire and attack machine guns with impunity, let us examine some of the limitations, that apply but feebly to cavalry, which will restrict the use of machines. The principal items are supply, control, and terrain.

The question of supply is far more binding upon machines than upon cavalry. Unlike men and horses, machines must have full rations. Even with full rations, their mechanical condition and efficiency deteriorate rapidly in field service. A liberal quota of replacement parts must be supplied, in addition to gas, oil and grease, to keep the machines running. Furthermore, these supplies must arrive regularly, at timely intervals, or the machines will quit in their tracks. Once immobilized, they are easily destroyed. During the German drives in the spring of 1918, British tank crews had to abandon and demolish over two hundred heavy tanks that had run out of gas; but it is not recorded that any of the British cavalry who helped stem the tide had to blow up their horses. With faster machines and more adequate measures for the supply of combat elements, it is true that many of the previous difficulties can be overcome. However, gasoline burns so readily that it requires a rare stretch of the imagination to picture a horde of machines living off the country, as cavalry has done many times in the past. Tank drivers are resourceful, but they have not yet learned how to dismount and lead.

Rider Wearing Especially Constructed Boots and Gloves and Both Rider and Mount Equipped with Latest Type Gas Masks to Counteract a Possible Effect of Modern Warfare.

Another important restriction on the use of machines is that imposed by the difficulties of control. Speed and power without control are useless. The British have been using radio phones in their tanks since 1926, and probably have the best control devices in the world. However, they have been unable to utilize in maneuvers more than half of the rated mobility of their machines. Accounts of their 1929 maneuvers indicate chaotic confusion in the engagement of comparatively small tank units, especially when infantry of the opposing sides became involved in the melee. Dust and smoke clouds rendered signal flags useless, and silenced the guns because it was impossible to distinguish friend from foe. Until reliable and rapid communications can be established and maintained between fighting machines, it will be practically out of the question for them to coöperate effectively in a sustained action.

A third limitation is that imposed by natural and artificial features of the terrain. Obstacles that appear trifling to a well-mounted cavalryman often put a serious handicap upon machines. Armored cars of the wheeled type, operating in woods, mountains, or where there are numerous streams, are practically confined to the roads. A mine or mine crater in the road, a bridge destroyed, a barricade, or a fallen tree—and the machine is stopped, perhaps under fire in a position from which withdrawal is difficult. The best of these machines, the French Berliet six-wheeler, has some remarkable cross country performances to its credit; but even this excellent machine becomes sluggish and difficult to control when forced to negotiate steep slopes or fields strewn with bowlders. In rough going, the wheeled machine has less mobility than the cavalryman, and its weapons are almost useless because the gunners cannot take good aim. In close country, where the machine has to stick to roads, its value as a fighting vehicle is materially reduced. The present cavalry weapons, if resolutely and resourcefully used, are sufficient to neutralize wheeled vehicles on the roads. In flat country, the wheeled vehicle can operate across country with great freedom. The British and French have made effective use of wheeled machines in northern Africa, Asia Minor and India. However, important military operations are seldom conducted in desert country; consequently, opportunities for the employment of wheeled vehicles under advantageous conditions will be limited.

Modern fast tanks are much more formidable. They can travel across country over extremely difficult ground, and can avoid or crush many of the obstacles that would stop a wheeled machine. In woods or mountainous country, they too are confined to the roads, and are thus at a distinct disadvantage as compared to the cavalryman. They cannot operate effectively where precipitous slopes, bowlders or streams obstruct their progress. Their rate of speed and accuracy of fire are considerably reduced by uneven ground, and they can readily be destroyed if they venture into areas that are unsuited to their proper use. The bogs of Flanders became the graveyard of many British tanks.

The combination wheel and track machine is the most adaptable to varying conditions of road and terrain. One

machine of this type, using wheels, has attained the rate of seventy miles an hour on a concrete road. Across country, on tracks, it has done better than forty-two for a short distance; and has averaged over fourteen for hour after hour, through rain, mud, red clay, and deep sand on the test course. The writers have observed closely the performance of this machine ever since it was first submitted for test in October, 1928, and are convinced from personal experience that it is a powerful weapon. They also know from personal experience that neither this machine nor any other that has yet been invented, could operate in those parts of northern Chihuahua where our cavalry not so long ago rounded up several hundred of Villa's followers. Even the most versatile machine could not have gone where our cavalry had to go.

REGARDLESS of the progress made in the development of fighting machines, cavalry will always be necessary. It will hold its own because no other agency can perform cavalry duties with equal reliability and dispatch. It can operate effectively in woods and mountains where machines cannot go; it can swim streams that would stop machines; and whether its supply trains come through or not, it can carry on day and night under any conditions of roads or weather. To expect mechanical vehicles—impotent without regular supplies, blind and deaf to control, and restricted by terrain—to take over these duties, is to expect the impossible. Each arm has its limitations and its proper sphere of usefulness.

Instead of rivalry, there should be union to insure strength. The infantry has its heavily armored tanks to lead the assault; the cavalry should have fast cross-country machines for extended rapid maneuver in operations against the enemy's front, flanks, and rear. The union of cavalry and mechanized units equipped for rapid maneuver would be natural, for they have much in common. Both are highly mobile; their tactics are similar; their actions develop and culminate rapidly; and their commanders, to be successful, must possess like traits. Each supplies in generous measure what the other lacks. We have dwelt upon the limitations of fighting machines in order to counteract the present tendency to over-rate their powers; but to deny that they are valuable weapons would be absurd. On suitable terrain, armored fighting machines are indeed formidable. The obvious thing for the cavalryman to do is to accept the fighting machine as a partner, and thus prepare to meet more fully the demands of future warfare.

HOW can fighting machines assist the cavalry? First, by helping to protect cavalry against the enemy's aircraft and armored vehicles. Protection against air attacks can be made remarkably effective by using machines armed with machine guns to cover the front, flanks and rear of cavalry on the march. Machine gunners thus mounted could engage the enemy, without wasting any time in placing their weapons in the firing position, before the hostile aircraft could reach the cavalry main body. The 1929 Cavalry Field Manual (page 395) states:—"Machine guns, once they are in position and ready for action, constitute cavalry's most effective weapon against hostile aircraft.* * * When mounted upon motor vehicles * * * they afford ideal antiaircraft protection for cavalry on the march." So far as antiaircraft protection is concerned, unarmored machines would be satisfactory; but we must also consider the enemy's fast tanks and armored cars. In 1922 a study prepared at the Cavalry School raised various questions concerning cavalry methods of defense against these new weapons. During the eight years that have elapsed since those questions were raised, fighting machines have been greatly improved. Defense against modern machines, especially in open country during the daylight hours, will be extremely difficult unless our cavalry has a liberal quota of fast cross-country vehicles with which to neutralize those of the enemy.

If provided with machines for its own security, cavalry will be better able to gain information and provide security for other forces. On reconnaissance in open country, its armored vehicles can cover long distances at a high rate of speed; and under favorable conditions, the machines will be of great value in extending the reach of the cavalry. For counter-reconnaissance, cavalry patrols could establish the screen and the machines, held centrally in reserve, could use their high mobility on previously reconnoitered terrain to drive back aggressive hostile forces. On flank guard work, the business of getting patrols out soon enough and far enough would be much simplified wherever the terrain permitted the use of machines. With a cavalry rear guard, and in delaying actions, armored vehicles could protect our flanks and threaten those of the enemy; make offensive returns to check the enemy's progress; or remain concealed in selected positions to cover the withdrawal of mounted troops. When cavalry has to hold a defensive position, its fighting machines could initially cover the position and eventually serve as a mobile reserve for counterattacks. In short, wherever the terrain is suitable and particularly in open country, fighting machines will be to the cavalry what cavalry is to the infantry.

For offensive operations in open country, cavalry can use fighting machines to great advantage. The Cavalry Field Manual (page 373) states:—"Tanks are valuable offensive weapons in practically all forms of combat where intense or stubborn resistance is to be overcome. Their use for this purpose facilitates a more rapid advance of cavalry." In an attack against troops in a defensive position, and during the initial stages of exploiting a breakthrough, there will be excellent opportunities for the employment of these machines. To mount an attack of sufficient magnitude to make a breakthrough requires immense supplies, whose movement congests the roads; but cavalry and its fighting machines can move to their appointed places across country. Heretofore, resistance met in passing through the breach has been costly to cavalry both in time and in casualties.

The fighting machine is here to stay and, if our cavalry has not lost its traditional alertness and adaptability, we will frankly accept it at its true worth. If the 14th century knight could adapt himself to gunpowder, we should have no fear of oil, grease and motors. Confident of our own power, we should give to the fighting machine the serious thought that it deserves. Field Marshal Allenby, one of the ablest cavalrymen of our times, said recently:—"I have never felt more confidence in our arm than I do today. It has retained the good, rejected the bad, and has not shrunk from the new."

The San Antonio Arsenal, San Antonio, Texas.

The San Antonio Arsenal

History and Activities of a Veteran Ordnance Establishment

By Everett Collins*

THE San Antonio Arsenal, which includes the San Antonio Ordnance Depot, is the main source of supply of ordnance material for troops in the Eighth Corps Area. It is situated in the heart of the historic city of San Antonio, Texas, from which it derives its name.

The city of San Antonio has been the theatre of military activities for over two centuries, dating back to the time the first garrison was stationed within its boundaries, after the arrival of the early colonists from Spain in 1718. The military history of San Antonio from that time on, is closely connected with the Spanish warfare with the Indians, the various filibustering expeditions into Texas, the revolt of Mexico from the dominion of Spain and later, the Texas War of Independence during which the memorable battle of the Alamo took place. During the brief existence of the Republic of Texas, this frontier town remained an important military center. After this followed the annexation of Texas to the Union and the war between the United States and Mexico. Some time after Texas was admitted to the Union, an ordnance depot was established in the vicinity of San Antonio, its mission being to maintain supplies in storage, issue arms and ammunition to troops and at times to the Texas Scouts when required in their warfare against the Indians.

The depot had been temporary in its location until 1858 when the War Department decided to establish an additional permanent arsenal in the southern area, and owing to the proximity of San Antonio to the Mexican border, this site was considered to be the most convenient in the event that trouble would recur with Mexico. The ordnance depot then existing in this vicinity was converted into an issue and repair arsenal called the Texas Arsenal, and Capt. R. H. K. Whiteley assumed command, pursuant to the following letter:

"Texas Arsenal,
July 1, 1858.

To: Col. H. K. Craig, Chief of the Ord. Dept.,
Washington City, D. C.

Colonel: I have the honor to report, that, I have this day assumed the command of this Arsenal.

I am Sir
Very Respectfully
Your Obt. Servt.,
R. H. K. Whiteley,
Capt. of Ordnance."

The reservation on which Texas Arsenal was located consisted of approximately 16 acres of land which were acquired by purchase from two Texas pioneer settlers, the deed conveying this property having been recorded in 1859. A deed from the Governor of Texas dated September 22, 1859, ceded jurisdiction over this tract of land to the United States Government for use as an arsenal in accordance with the Constitution and special acts of the Legislature of the State of Texas.

During the administration of Captain Whiteley from the date he took command until it was taken over by the Confederates in March, 1861, the arsenal functioned as an important ordnance establishment. It was during this period that the ground was cleared, board fences at boundaries

*Commanding Officer, San Antonio Arsenal, San Antonio, Texas. Major, Ordnance Department, U. S. Army.

erected, construction of office building and magazine now being used was started and work on several temporary buildings was begun.

During the year preceding the Civil War some ninety requisitions for ordnance stores were acted on and 5389 small arms were repaired and cleaned.

All records pertaining to the arsenal prior to November, 1865, were, it is believed, destroyed by the Confederates as diligent search has failed to reveal any in the files.

Commanding Officer's Quarters, San Antonio Arsenal.

IN November, 1865, after the close of the Civil War, Capt. J. W. Todd assumed command of the arsenal called from that time on the San Antonio Arsenal, and at once proceeded to get all Government property together and existing affairs adjusted. As the fence which had at one time afforded some protection had been destroyed by the Confederates, it was necessary to request from the commanding officer of troops stationed at San Antonio, sentinels to guard the property, and this method of protection was continued until a new picket fence was constructed.

It was found that the following buildings had been left by the Confederates: the commanding officer's quarters, magazine built of cut stone left unfinished by Colonel Whiteley and finished by the Confederates; armorer's shop started by Colonel Whiteley and finished by the Confederates; office containing two rooms and hall built by Colonel Whiteley and left intact by the Confederates, and four frame buildings built by the Confederates, which though found in a bad state of repair, could be used for storage purposes.

After a survey of the situation had been made, an estimate was submitted for funds to make necessary repairs, but due to the remote location of the arsenal from the sources of supply of building materials, little construction work was undertaken until 1872, when a building to be used as a machine shop was constructed at an estimated cost of $15,000. This building during the World War was enlarged and is at present used as a machine shop. The next record of any construction appears in 1873 when a building of stone was erected presumably for the commanding officer, but was later turned into noncommissioned officer's quarters. During this year a building was constructed of stone and lumber at an estimated cost of some $20,000 and is at present used as a storehouse. In 1883 a two-story wood and stone building was constructed for the commanding officer at an estimated cost of $15,000. In these buildings the activities of the arsenal were carried on until the outbreak of the Spanish-American War.

In 1898 there were assembled in San Antonio, a regiment of Rough Riders organized by Colonel Roosevelt and other volunteer troops, besides many new regiments of Regulars, all of whom were more than anxious to start for the front. Before they could move, however, it was necessary that they be armed and properly equipped, and a great part of this work naturally fell upon San Antonio Arsenal. At this time a frame building was constructed, which was used as a carpenter and harness shop. In this old frame building which is still used as a carpenter shop, repair work was carried on extensively in outfitting the troops ordered for duty in foreign countries.

From the close of the Spanish-American War on, the development of the arsenal was slow until the year 1916, when General Pershing and his men were stationed on the Mexican border and later entered Mexico on the Punitive Expedition. During this period much additional work was thrown on the arsenal, its facilities being greatly increased and expanded in every way.

After the entry of the United States into the World War, the activities of the arsenal were still further increased and it became necessary again to enlarge greatly the existing facilities.

A standard gage railroad track was constructed which connected with the Missouri, Kansas and Texas Railway, and this provided means for direct delivery of freight to the warehouses within the arsenal grounds. The machine shop built in 1872 was enlarged and new machinery was installed, a small arms shop, modern warehouses with freight elevators, sprinkler systems and plumbing and sewerage connections were constructed, which, with alterations and repairs made to existing buildings, involved an expenditure of some $513,000.00. An adequate system of water supply was provided by the drilling of an artesian well which is 836 feet deep, has an eight-inch casing and

Method of Storing Trucks, San Antonio Arsenal.

flows 1,050 gallons to the minute under pressure of 22 pounds. This water, which is used in quarters and shops, is also piped to different parts of the reservation, and in dry weather used for irrigating purposes.

In passing the arsenal grounds today, one sees a modern military reservation: expansive grounds beautified with large shade trees of many varieties, pecan prevailing; substantial roads and walks, well kept lawns and comfortable quarters for commanding officer and noncommissioned offi-

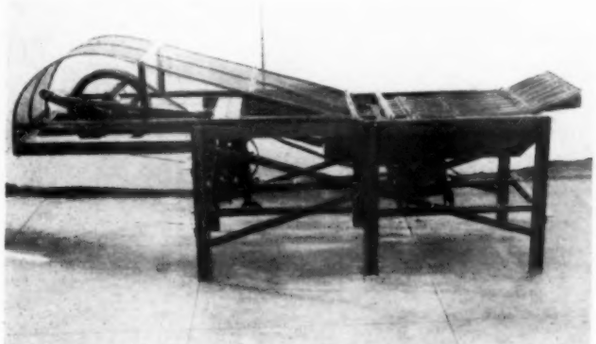
cers stationed there. An attractive stone and iron fence extends across the entire front of the reservation and the other boundaries are enclosed by modern steel wire and wooden fence. On the reservation there are 11,183 square yards of hard-surfaced roads.

THE present functions of San Antonio Arsenal are as follows: (a) To supply ordnance matériel to troops in the Eighth Corps Area, and other portions of the United States and its insular possessions. It thus operates as a wholesale supply base, for the issue of arms, ammunition and equipment for the States of Texas, Oklahoma, Arizona, New Mexico, Colorado and Fort D. A. Russell, Wyoming, the National Guard, Reserve Officers Training Corps and Citizens Military Training Corps units. (b) To provide storage facilities for war reserve matériel. (c) To overhaul, modify, repair and place in serviceable condition, all classes of material and equipment sent in by the regular troops, militia and various other organizations in the Eighth Corps Area. (d) To manufacture field artillery and small arms target material, packing boxes, packing and chests.

The Administration Department is located in the original office building constructed in 1860, which has been enlarged by the addition of a frame building and makes an excellent office. This division functions as a coördinating unit for all other departments. The subdivisions of this office are the mail and record, allotment and finance, civil service and employment, purchasing section, stock record, ordnance provision system and current service.

The following is a list of officers who have been in command at San Antonio:

Capt. R. H. K. Whiteley.....July 1, 1858—Mar. 11, 1861
Col. Sackfield Maclin, C. S. A.....Mar. 12, 1861—Oct. 1, 1863
Col. Philip Stockton, C. S. A.....Oct. 2, 1863—Mar. 15, 1865
Capt. J. W. Todd.....Nov. 16, 1865—Dec. 30, 1866
Lieut. Isaac Arnold.....Dec. 31, 1866—Aug. 6, 1869
Capt. J. C. Bradford.....Oct. 24, 1869—Nov. 11, 1870
Capt. Clifton Comly.....May 5, 1871—Nov. 18, 1879



Rifle Cleaning Machine Designed and Built at San Antonio Arsenal.

Capt. F. H. Phipps.....Nov. 19, 1879—June 15, 1882
Capt. John A. Kress.....June 16, 1882—Nov. 10, 1883
Maj. Isaac Arnold (re-detailed)..Nov. 11, 1883—Nov. 22, 1887
Maj. L. S. Babbitt.....Nov. 23, 1887—Oct. 5, 1890
Maj. Wm. A. Marye.....Oct. 6, 1890—June 3, 1891
Maj. Clarence E. Dutton.....June 17, 1891—May 15, 1899
Maj. Almon L. Varney.....May 16, 1899—Apr. 4, 1903
Maj. Daniel M. Taylor.....Apr. 5, 1903—July 3, 1903
Lieut. Col. John Pitman.....Aug. 23, 1903—Nov. 11, 1906
Lieut. Col. Frank Baker.....Nov. 12, 1906—Oct. 26, 1907
Lieut. Col. Chas. H. Clark.....Nov. 26, 1907—Dec. 19, 1912
Maj. John H. Rice.....Dec. 20, 1912—Jan. 24, 1915
Maj. H. B. Jordan.....Jan. 25, 1915—Aug. 18, 1917
Lieut. Col. Kenneth Morton.....Aug. 22, 1917—July 23, 1918
Lieut. Col. F. W. Hinrichs, Jr.....Aug. 4, 1918—Aug. 30, 1919
Lieut. Col. R. N. Bodine.....Aug. 31, 1919—Oct. 3, 1919
Col. A. F. Casad.....Oct. 4, 1919—Nov. 13, 1920
Maj. H. S. Aurand.....Nov. 14, 1920—Dec. 4, 1920
Col. Odus C. Horney.....Dec. 5, 1920—Dec. 10, 1921
Maj. C. T. Richardson.....Dec. 11, 1921—Oct. 19, 1922
Maj. C. T. Harris, Jr.....Oct. 20, 1922—July 10, 1923
Maj. P. J. R. Kiehl.....Aug. 6, 1923—Aug. 15, 1926
Maj. Everett Collins.....Aug. 16, 1926—April 10, 1930

Machine for Breaking down Caliber .45 Ammunition Designed and Built at San Antonio Arsenal.

The division known as the Manufacturing, Inspection and Maintenance Department is charged with the coördinating of all activities pertaining to manufacturing of supplies, inspection of buildings, roads, material in storage and maintenance of all.

In the machine shop all classes of field artillery matériel including tanks, tractors, mountain guns, carts and carriages, are inspected, overhauled, and after work on them is completed, are either placed in storage or returned to organizations from which they were received for repair. In this building are located the drafting, photostatic and multigraph departments and the office of the shop superintendent where necessary administration and clerical work of the mechanical division is conducted. Here also a file of War Department drawings is maintained.

In the small arms shop, which was built after the entry of the United States into the World War, much activity is now found. The shop is well equipped, having a Parker rust proof process plant, an efficient device for greasing small arms, a machine for the cleaning of rifles for inspection purposes and a bore-sighting device which was invented by Mr. H. E. Coleman, the present Superintendent of Shops. In this shop rifles, pistols, automatic guns and other small arms are reconditioned and overhauled.

In the carpenter shop, which is a frame building with concrete floor, are found many up-to-date machines, each driven by its own motor. Here, in addition to the repair work carried on, is manufactured a large quantity of target material each year. Many boxes and crates are manufactured and much work is done on numerous chests turned in for repair. To accomplish this, lumber is delivered in carload lots direct from the spur track to the receiving department. This shop being located in an old frame building presents a fire hazard, and to overcome this as much as possible, connections have been made to the air compressor located in the machine shop, and all dust and accumula-

tions deposited on the walls and rafters are frequently blown away.

In the optical shop, which is located on the fourth floor in one of the modern storehouses constructed during the World War, is carried on the work of repairing and rebuilding all classes of fire-control equipment, such as range-finders, telescopes, azimuth instruments and other optical instruments.

The leather, paint, electrical, plumbing and blacksmith shops are carried as such on the organization chart in order to provide for expansion. They are very small at the present time, but all contribute to the operation of the establishment.

At the present time, there is no ordnance company stationed at the arsenal, and the upkeep of the reservation, consisting of approximately 20 acres, in a great measure depends upon the roads and grounds department.

THE supply department of the San Antonio Ordnance Depot is charged with maintaining all records connected with the receipt, storage, maintenance and issue of ordnance material. The main office of the superintendent of storage is located in one of the modern storehouses built during the late war.

Modern fire-proof warehouses of concrete-steel construction, together with storehouses of a more or less temporary nature, are available for the storage of material on hand. The warehouses of concrete-steel construction are used for storage of rifles, machine guns, pistols and the like, while artillery and vehicles pertaining thereto, together with tanks, tractors and trailers, are stored in the temporary buildings.

Due to the nature of the soil, considerable difficulty was at first experienced in storage of motor vehicles. This was brought about by the fact that the buildings in which they were stored had no floors and the vehicles, after being jacked up and placed, moved considerably, due to the shifting of the ground after a rain. To relieve this situation, all vehicles were removed from the building, a coating of gravel was placed on the ground and the vehicles were arranged as shown in the illustration. This work was done in the spring of 1927 and no difficulty of this nature has since been experienced. Storage in this manner makes all vehicles accessible and greatly facilitates inspection and work on them.

While the San Antonio Ordnance Depot proper is located at the arsenal at San Antonio, a branch of the depot is located at Camp Stanley, some 23 miles distant in a northerly direction.

Prior to and during the World War, very small quantities of pyrotechnics, high explosives and their components were in storage at the arsenal. Shortly after the Armistice was signed and the closing of ordnance depots in other parts of the country, large quantities of pyrotechnics, high explosives and their components were ordered shipped to the depot. In view of this expansion of activities and the necessity for storing material of this kind at more or less remote places, a site for this purpose was secured at Camp Stanley. The ordnance activities carried on at the sub-depot at Camp Stanley are divided into two departments—the ammunition storage area proper and the ammunition process plant.

The ammunition storage area comprises 44 buildings, the greater number of which are temporary frame structures originally constituting a regimental area which was built for a unit at war strength. The area in which these buildings are located is rolling, and in many cases the floors of the buildings are several feet away from the ground, which of course reduces materially the amount of floor load and adds to storage problems. This has in cases been overcome by the construction of concrete floors.

Weeds and grass flourish in this area and the cutting of this rank vegetation presents a problem which has, it is believed, been solved by the purchase of sheep from the detachment fund and the grazing of them in the area. Firebreaks have been kept around the fence and buildings by the successful use of an ordinary road grader hauled about by either truck or tractor.

To maintain ammunition and other supplies in storage, it became necessary to install a surveillance laboratory with necessary equipment to conduct proper tests of supplies and a shop with machinery and apparatus required to perform maintenance work. The work carried on in these two sections comes under the ammunition process plant.

SOME few months ago, the process plant was faced with a problem for solution that was new to the personnel on duty in the department. This problem was the breaking down of small arms ammunition in large quantities and shipping the components for remelting purposes.

A machine was built at the arsenal for the breaking down of caliber .30 ammunition and has proved most satisfactory. The principle of this machine is simplicity in itself. A shaft in which ten fingers are placed, revolves and extracts the bullets from the cartridge cases; the bullets fall into one receptacle, the powder into another and the cases into another. The empty cases are then put in a bake pan, placed in a field oven and the primers burned or roasted.

The available storage space at the arsenal is 259,268 square feet and at Camp Stanley 283,456 square feet. This includes both the closed and open storage.

The present personnel consists of two commissioned officers, two warrant officers, three technical sergeants, one staff sergeant and one hundred and eleven civilian employees.

It is estimated that the value of the land constituting the San Antonio Arsenal reservation at the present time is $775,000; buildings $875,000; furniture and fixtures, $25,000; utilities and improvements $350,000, and stores aggregating $28,050,000. In addition to this, the estimated value of the stores at Camp Stanley is $2,500,000.

The phenomenal growth of the San Antonio Arsenal within the past twelve years and the part it took in the World War have proved this establishment to be one of great importance. It is of particular strategic value, being the only large ordnance supply base of the Army situated near the southern coast and the Mexican border. Owing to improvements made in recent years, it is now well equipped to perform all kinds of repairs on ordnance matériel and to manufacture in larger quantities than heretofore target material of all descriptions. War plans which have been completed provide for a rapid and immediate expansion of all facilities.

Association Affairs

Annual Meeting of Officers and Directors

THE regular annual meeting of the Officers and Directors of the Army Ordnance Association was held in New York City, January 30, 1930. A transcript of the proceedings follows:

Held at 100 East 42nd Street in the Board Room of the Irving Trust Company, in the Borough of Manhattan, City of New York, on the 30th day of January, 1930, at 11:15 in the forenoon.

There were present: Benedict Crowell, President; William C. Spruance, Vice-President; John Ross Delafield, Counsel; Chas. Elliot Warren, Treasurer; Frank A. Scott, Director, and L. A. Codd, Executive Secretary, and, by invitation, Maj. Chas. R. Baxter, former Secretary of the Association.

The President called the meeting to order and the Executive Secretary was about to read the minutes of the last meeting, when, on motion duly made, seconded and carried, the reading of the minutes was dispensed with and they were approved as recorded.

The President then called upon Brig. Gen. Chas. Elliot Warren, Treasurer, for his report on the financial condition of the Association. The Treasurer reported cash balances as of December 31, 1929, of $5,054.21, and the addition of $9,484.88 to the Investment Account during the year. He likewise called attention to the annual audit of the accounts which was made by Messrs. Ernst and Ernst, Certified Public Accountants, as of December 31, 1929, which declared the accounts of the Association to be correct and in good order. He suggested that further additions of surplus funds be added to the Investment Account as has been done previously under the jurisdiction of the Finance Committee.

On motion duly made, seconded and carried, it was unanimously resolved that the Treasurer's report be accepted with thanks and approved as rendered.

The annual report of activities and affairs of the Association for the calendar year ending December 31, 1929, was read by the Executive Secretary and was followed by discussion.

The report follows, in part:

"I have the honor to submit the following report of activities and affairs of the Army Ordnance Association for the calendar year ended December 31, 1929, together with statements of the financial condition at that time. I submit also for your approval recommendations in respect of activities for the year 1930.

"Since, by appointment of the Board of Trustees, I became Executive Secretary of the Association on October 19th, by far the greater part of the activities of the year 1929 is due to the efforts of my predecessor, Maj. Charles R. Baxter, who tendered his resignation as of October 14th. Under his guidance the activities of the Association for the past three years have grown more than at any time in the history of the organization. Upon assuming the office of Executive Secretary, at my suggestion and with the concurrence of the President and Treasurer, I executed a fidelity bond to the Association in the amount of $10,000, the National Surety Company as surety.

During 1929 there was a net increase in members of 54. The gross increase was 455, while 401 old members, by resignation, death, and non-payment of dues, were dropped from the roster. The percentage of members dropped is lower than that of previous years. The total membership, all classes, as of December 31, 1929, is 3440, which is slightly lower than the total for November, 3454, which is the highest membership in the history of the organization. During 1929 fifteen new group members were enrolled while 4 resigned.

"The new Constitution and By-Laws put into effect at the time of the incorporation of the Association in January, 1929, were published in ARMY ORDNANCE and have been prepared in booklet form and are supplied to all new members of the Association. As a means of explaining the aims and purposes of the organization, a booklet on this topic was prepared and has been found very helpful.

"The Spruance endowment, made possible by the gift of Col. W. C. Spruance, Vice-President, providing for five faculty and five student memberships at the School of Engineering, Princeton University, became effective in October, 1929. During the year eight members were admitted to life membership—a new form of membership provided for in the new Constitution.

"The Eleventh Annual Meeting of the Association was held at the Aberdeen Proving Ground, Md., Thursday, October 10th, with the National Aeronautic Association and the National Metal Trades Association participating. It is conservatively estimated that 12,000 members and guests were present. Approximately 3200 meals were served (breakfast, 137; caterer's dinner, 400, caterer's supper, 461; box lunches, 2,084, special guests, 150).

"Not only was the attendance larger than in any previous year, but all details connected with the meeting were well planned and executed. The program of demonstrations by the Ordnance Department and other branches of the Army, including an exhibition by the Air Corps, proved most interesting and instructive. All details connected with the handling of the large crowd were admirably made and carried out and reflect great credit upon Col. E. M. Shinkle, Commanding Officer of the Proving Ground, and his assistants. The Association is likewise under a deep debt of gratitude to the War Department and particularly to Maj.

Gen. C. C. Williams and the officers of the Ordnance Department for their splendid coöperation.

"Through the assistance of the Recruiting Publicity Bureau at Governors Island, all publicity connected with the meeting was handled by that organization. From a general survey of publicity carried by the daily press there were approximately 200 columns of space given the event throughout the country.

"At the business meeting proper, which was seriously impeded for lack of time, addresses were made by Hon. Benedict Crowell, President of the Association; Hon. Hiram Bingham, Senator from Connecticut and President of the National Aeronautic Association; General Williams, Chief of Ordnance, and Mr. Harold C. Smith, President of the National Metal Trades Association. Due to the lengthy program beginning at 10 a. m. and concluding at 7:30 p. m., replete with exhibits and demonstrations, it is growing more impracticable each year to devote much time to the technical discussions of ordnance problems. I have made this a subject of recommendation which appears later in this report.

"During 1929 no new local posts were organized. There are ten local posts in existence as follows: Boston (membership 91), California (membership 141), Chicago (membership 115), Cincinnati (membership 85), Milwaukee (membership 61), New York (membership 321), Philadelphia (membership 284), Pittsburgh (membership 78), St. Louis (membership 98) and Washington (membership 48). The total number of members affiliated with local posts is 1322, or approximately 38½ percent of the total Association membership. It is hoped that the coming year will make practicable the organization of several new local posts.

"Constant effort was made during the year toward further improvement of Army Ordnance both as to text matter and typographical arrangement. The average size of the journal was 76 pages and cover, while the average press run was 4500. The new front cover designs by Joseph Pennell added greatly to the appearance of the magazine. Six new cover designs have been obtained from the noted American artist, Mr. Vernon Howe Bailey, the first of which is to appear with the January-February 1930 issue.

"The Ordnance trophy, a caliber .22 Sport Model Springfield Rifle, for award to the winner of the President's Match of the National Rifle Matches, was awarded to Ensign C. E. Coffin, U. S. N. Two prizes of $50 each were awarded to members of the First Class, U. S. Military Academy, for the best paper submitted on an ordnance subject. The winner of the first prize was Cadet Frank M. Steadman. The second prize was awarded to Cadet Robert G. H. Meyer and the third to Cadet Fred R. Dent, Jr.

"The excess of receipts over expenditures, with all bills paid, was $5,132.19. $9,484.88 was withdrawn from cash and added to the investment account. Of this amount, $4,000 was from operations of 1928 (invested during January, 1929), $822.50, the market value on date of donation, of seven shares of E. I. duPont de Nemours & Co. Debenture Stock, presented by Colonel Spruance for the Princeton endowment, and $4,662.38 invested during December, 1929, from cash accumulated during that year.

"An audit of the finances of the Association was made by Messrs. Ernst and Ernst, certified public accountants, as of December 31, 1929. The audit covered the fiscal year 1929, the last previous audit having been made by the same organization as of December 31, 1928. The accounts of the Association were found to be correct and in good order. Certified copies of the audit report are available for the information of Officers and Directors.

"While the activities of the Association for the past year are highly satisfactory from a financial standpoint, it is felt that the prime purpose of the organization, the spreading of interest in and knowledge of munitions design, which in the final analysis is indicated by the number of members of the organization, has not progressed as it should. It will be noted from the items listed in the proposed expenditure budget that additional effort and planning are necessary looking toward a larger membership. Not only are continual extension activities required to amortize normal attrition, but consistent campaigning through correspondence and personal contact is essential if membership is to grow. It is believed that by concentrating on this phase of our work, a membership of at least 5,000 is possible.

"It has become increasingly apparent in recent years that the organization functions of the Association cannot be fulfilled adequately as conducted at present. The only opportunity for a meeting of the Association in the strict sense of the term, is during the short period allotted on the program of demonstrations at our Aberdeen meeting. It is increasingly obvious that the Association should carry on more functional activities and means, therefore, should be provided. I suggest that on the night preceding the annual meeting at Aberdeen there be held in Washington, D. C., a national meeting of the Association for the discussion of the affairs of the organization and the work to which it is pledged. At such a gathering committee reports should be submitted, resolutions adopted and technical papers read and discussed. On the day following, those who attend the business meeting could easily make the journey from Washington to the Proving Ground."

The balance sheet as approved by Messrs. Ernst and Ernst, Certified Public Accountants, referred to in the report is:

Assets

Cash on hand	$	15.00
Cash on deposit:		
Association Account		2,846.13
Magazine Account		2,208.08
Demonstration Fund		101.58
Accounts receivable:		
Due from advertisers		65.00
Other Assets:		
Securities owned		31,367.65*
Postage		225.74
Permanent:		
Furniture, fixtures and supplies		1.00
	$	36,830.18

Liabilities

Unearned Income:		
Prepaid membership dues	$	9,948.48
Prepaid subscriptions to magazine		812.25
Reserve:		
Endowment reserve		822.50
Life member reserve		800.00
Operating Reserve		24,446.95
	$	36,830.18

*Cost. Market value December 31, 1929, $31,412.30.

The recommendation contained in the report regarding increased membership, the appointment of committees on endowments and life membership was approved as also was the recommendation regarding the annual meeting in Wash-

ington, D. C., on the evening preceding the usual meeting at the Aberdeen Proving Ground.

Colonel Spruance, discussing the possibilities of obtaining a larger number of student members of the Association, suggested that consideration be given this subject. The Executive Secretary was directed to give special attention to the possibilities of recruiting more student members during 1930 and to take up the question again before the Board at its next regular meeting.

On motion duly made, seconded and carried, the annual report of the Executive Secretary together with the recommendations and the amendments to the budget for 1930, was approved.

The chairman thereupon called for reports of officers and committees.

On motion duly made, seconded and carried, it was unanimously resolved that the Twelfth Annual Meeting of the Association be held in Washington, D. C., on the evening of Wednesday, October 8th, and with the approval of the Secretary of War at the Aberdeen Proving Ground, Md., Thursday, October 9th, and that the National Defense Committee, U. S. Chamber of Commerce, be invited to participate.

The President then presented for discussion Senate Joint Resolution No. 20, entitled, "To Promote Peace and Equalize the Burdens of War and to Minimize the Profits of War," providing for a joint committee of Senators, members of the House of Representatives and civilians to be appointed respectively by the Vice President, the Speaker of the House of Representatives and the President, to investigate and recommend legislation for the equitable and efficient prosecution of war. After lengthy discussion and on motion duly made, seconded and carried, it was unanimously resolved that the President and Executive Secretary prepare a resolution embodying the sentiment of the Trustees and Directors on the proposed joint resolution and that drafts of the resolution thus prepared be forwarded to all officers and directors for comment.

The President next presented for discussion a joint resolution now pending in Congress entitled, "To Investigate the Pay Allowances of the Commissioned and Enlisted Personnel of the Army, Navy, Marine Corps, Coast Guard, Coast and Geodetic Survey, and the Public Health Service," providing for the appointment of a joint committee of Senators and members of the House of Representatives to recommend legislation for the investigation of present inequalities of service pay and the recommendation of suitable legislation to remedy the same. After discussion it was unanimously moved, seconded and carried, that the Association take no formal action on the matter at this time.

There being no further business, and on motion duly made and seconded, the meeting adjourned.

Washington Post

THE Washington Post resumed its activities with a meeting held at the Army and Navy Club in Washington, February 5. Luncheon was served at noon at which 55 members were present. At the meeting following, Lt. Col. C. G. Mettler, Ord. Dept., U. S. A., Vice President, and in the absence of and under authority from Gen. James A. Drain, President, presided. At the speakers' table were Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., Brigadier Generals C. L'H. Ruggles and Samuel Hof, Assistants to the Chief of Ordnance, and Brig. Gen. V. H. Moseley, Executive Assistant to the Assistant Secretary of War.

Lt. Col. R. W. Case, Chairman of the Committee on Constitution and By-Laws, submitted and read a draft of a proposed constitution. After amendment to provide for two vice-presidents, the constitution was unanimously adopted.

Col. J. O. Johnson, Ord. Res., Chairman of the Nominating Committee, placed in nomination the following: President, Lt. Col. C. G. Mettler; 1st Vice-President, Lt. Col. Henry P. Erwin; 2nd Vice-President, Dr. Chas. E. Munroe; Directors to serve four years: Maj. Gen. C. C. Williams, Chief of Ordnance, exofficio; Hon. Robert P. Lamont, Hon. Swagar Sherley, Howard Bruce; Directors to serve two years: Col. Geo. B. McClellan, Col. Fred. E. Wright, Maj. LeRoy Hodges. All of the nominees were duly elected.

Colonel Mettler, the new President, announced plans for a series of monthly meetings to be held during the spring and early summer. The first of these was held at the Army and Navy Club on March 5th when, following luncheon, Col. Pope Hennessy, British Military Attaché at Washington, was the principal speaker. He described some of the more important troop movements and problems connected with the Mesopotamian Campaign.

Chicago Post

THE annual meeting of the Chicago Post, Army Ordnance Association, was held January 30th in the Red Room of the Hotel La Salle. The principal speaker was Lt. Col. Calvin Goddard, Ord. Res., who spoke on the identification of firearms and projectiles in criminal cases, and described the evidence in the Sacco-Vanzetti and Hall-Mills cases, and the Chicago St. Valentine's Day Massacre. Mr. E. A. Russell was called on and gave a brief resumé of the work of the Chicago District Ordnance Office and supplied two of his inimitable stories which were well received.

Among the prominent members and guests present, besides those already mentioned, were: Wm. Butterworth, President of the United States Chamber of Commerce; Maj. Gen. Frank Parker, Commanding General, Sixth Corps Area; Col. M. B. Stokes, Chief of Staff, Sixth Corps Area and many men of great local prominence in and about Chicago. The total attendance was somewhat over 100. Major Alex. K. Hamilton, the president, presided.

Cincinnati Post

THE annual meeting of the Cincinnati Post was held in the banquet hall of the Chamber of Commerce on February 12, the Reserve Officers' Association of Cincinnati participating.

Col. C. H. Harrison, Chief of the Cincinnati District, presided. The principal address was made by Brig. Gen. Peter E. Traub, U. S. A. Ret., former Commanding Officer at Fort Thomas, who, in commemoration of Lincoln's birthday, drew some very timely conclusions from the life of the Great Emancipator in the light of present day preparedness developments.

Maj. Donald Armstrong, Ord. Dept., U. S. A., spoke on the planning activities of the Office of the Assistant Secre-

tary of War. He outlined in interesting detail the various problems connected with that work and the steps being taken toward their solution. Capt. J. W. Jannicki, National Field Secretary of the Reserve Officers' Association, also spoke.

Pittsburgh Post

AT the regular annual meeting of the Pittsburgh Post held in the ball room of the William Penn Hotel on the evening of Wednesday, March 5th, there were approximately 200 members and guests in attendance. Mr. Ralph M. Dravo, Chief of the Pittsburgh Ordnance District and a Director of the Army Ordnance Association, was toastmaster. Addresses were made by Hon. F. Trubee Davison, Assistant Secretary of War for Aeronauties, Maj. Gen. Lytle Brown, Chief of Engineers; Brig. Gen. C. L'H. Ruggles, Assistant to the Chief of Ordnance; Mr. Taylor Alderdice, President, Pittsburg Post, Army Ordnance Association; Maj. E. L. Messler, President, Pittsburg Post, Society of American Military Engineers, who were jointly represented at the meeting; and Maj. L. A. Codd, Executive Secretary of the Army Ordnance Association. Mr. Davison complimented the industrialists of Pittsburgh on their continued interest in the problem of munitions supply. General Brown made particular reference to inland waterways development, and General Ruggles spoke on the current status of industrial preparedness plans.

Bridgeport

A MEETING of Reserve Officers and manufacturers of the Bridgeport Ordnance District was held at the Farmington Country Club, Farmington, Conn., on January 30th. This was one of a series of meetings held during the winter months in the principal cities of the district, and in point of attendance as well as of interest in industrial preparedness, was one of the best meetings which the district has ever held.

Arrangements for the meeting were in charge of a committee consisting of Mr. C. R. Burt, Vice-President and General Manager of the Pratt and Whitney Company, Hartford, Conn., Chairman; Mr. S. M. Stone, President of the Colt's Patent Fire Arms Manufacturing Company, Hartford; and Mr. P. B. Gale, President of the Hartford Machine Screw Company, members of the District Advisory Board, and Maj. J. W. MacMorris, Spec. Res., Manager of The Skayef Ball Bearing Company, Hartford. The success of the meeting was due in large measure to the work of this committee.

Col. B. A. Franklin, District Chief, presided at the meeting and introduced as the first speaker Hon. W. E. Batterson, Mayor of Hartford.

The principal speaker of the evening was Col. T. C. Dickson, Commanding Officer, Watertown Arsenal. His subject was "Recent Developments at Watertown Arsenal." The recent advances in metallurgy and, particularly, in electric welding were described and aroused very great interest among the guests present. The lecture was illustrated by lantern slides.

Boston

COL. T. C. Dickson, Commanding Officer, Watertown Arsenal, was the guest speaker at a luncheon of the Rotary Club of Boston held at the Hotel Statler, February 12th. Introduced by Maj. Reuben Goho, an active member of the Association and of the Boston Rotary Club, Colonel Dickson told of the changes effected in the construction of guns which have resulted in large savings of material and in greatly speeded production. He described the welding process of assembling gun carriages and the cold-working method of gun casting.

Association Membership

THE Association has its government vested in a Board of Directors, six of whom are elected by general ballot of the entire membership, for terms of four years, and one director representing each local post, the latter being elected by the respective posts. The officers, with one director elected by the Board of Directors, constitute the Board of Trustees which has the active management of the affairs of the Association. The President and Vice-Presidents are elected every two years by general ballot and the Counsel, Treasurer and Executive Secretary are appointed by the Board of Directors. The Association was incorporated in 1928 under the laws of the District of Columbia.

Over 90 per cent of the membership of the Association consists of executives and engineers of American industry who are cognizant of the importance of industrial preparedness. These gentlemen who, through affiliation with the Association are kept informed of current development of munitions, constitute a large portion of the civilian nucleus upon whom our Government will depend for the manufacture of ordnance in time of emergency.

The following extracts from the Constitution and By-Laws of the Association define the several classes of membership.

"SEC. 1. Full membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"SEC. 2. Life membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"Life membership shall continue during the lifetime of the life member and shall expire at death. It shall not be transferable.

"SEC. 3. Student membership in the Association shall be open to all men who are American citizens and who are students in technical schools or colleges. Student members shall not vote or hold office in the Association.

"SEC. 4. Group membership in the Association shall be open to all individuals, firms, companies and groups controlled by American citizens who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"Group members shall have the privilege of nominating ten men for full membership in the Association, and members thus nominated shall pay no dues.

"SEC. 5. Honorary membership for life shall be conferred, in the discretion of the Board of Trustees, upon persons who have rendered meritorious service to the cause of industrial preparedness. Honorary members shall be

entitled to all privileges of full membership except as otherwise provided in this Constitution and in the By-laws."

By-Laws

"5. The fee for life membership in the Association shall be One Hundred ($100.00) Dollars. The annual dues for membership in the Association shall be, for members, Five ($5.00) Dollars; for student members, Two Dollars and Twenty-five Cents ($2.25); and for group members, One Hundred ($100.00) Dollars, payable in advance. These sums are in addition to whatever dues or assessments may be imposed by the respective local posts in the case of members."

The annual meetings of the Association are held, with the approval of the War Department, at the Aberdeen Proving Ground, Maryland, usually during the month of October. Demonstrations of latest standard and experimental types of Army equipment are featured at these meetings. They have become the foremost industrial preparedness event of the year, attracting increasing numbers of executives, manufacturers and engineers.

Meetings of local posts are held periodically and offer an excellent means for discussion of munitions and other technical problems and for social contact.

Deceased Members

SINCE publication of the last issue of ARMY ORDNANCE, National Headquarters has learned with regret of the death of the following members: Lt. Col. D. C. T. Grubbs and Mr. Charles F. Brush. On behalf of the Association sympathy is extended to their families.

New Members

THE following have been admitted to membership in the Association since January 1, 1930: Alfred A. Albiani, Newton, Mass.; James D. Armour, Beaver, Pa.; Charles H. Beech, Wilkinsburg, Pa.; J. G. Benedict, Waynesboro, Pa.; Willard E. Bleick, Maplewood, N. J.; M. B. Bradley, Milwaukee, Wis.; C. A. Campbell, Watertown, N. Y.; J. D. Cartin, Watertown, N. Y.; James A. Clifford, Philadelphia, Pa.; J. J. Coffey, Bethlehem, Pa.; Charles H. Coles, Hartford, Conn.; R. G. Cook, Bethlehem, Pa.; L. E. Creighton, Beaver Falls, Pa.

Fred H. Davis, Tallahassee, Fla.; R. S. A. Dougherty, Bethlehem, Pa.; William M. Dunlap, Oakmont, Pa.; Eugene E. duPont, Wilmington, Del.; C. C. Farmer, Pittsburgh, Pa.; David P. Forstner, Philadelphia, Pa.

Thomas L. Gaines, Portsmouth, Va.; B. B. Greer, Watertown, N. Y.; H. G. Grim, Pittsburgh, Pa.; H. F. Halladay, Watertown, N. Y.; F. D. Hansen, Milwaukee, Wis.; H. King Hathaway, New York, N. Y.; Henry G. Heedy, Youngstown, Ohio; N. Hicks, Watertown, N. Y.; Ernest H. Holzworth, Niagara Falls, N. Y.; John P. Hosack, Niles, Ohio; John Irwin, Colorado Springs, Colo.; A. W. Ives, Boston, Mass.

Raymond A. Keenan, Cleveland, Ohio; Lynn H. Korndorff, Kearney, N. J.; Fred A. La Belle, Youngstown, Ohio; George M. Laughlin, Jr., Pittsburgh, Pa.; Geo. C. Lilly, Bethlehem Pa.; James Lippincott, Pittsburgh, Pa.; C. R. Lund, Milwaukee, Wis.; Robert E. Maxwell, Pittsburgh, Pa.; William S. McAbee, Pittsburgh, Pa.; P. E. McKinney, Bethlehem, Pa.; William J. Menke, Sharpsville, Pa.; C. W. Messinger, Philadelphia, Pa.; John Mitchell, Chicago, Ill.; Will H. Mooney, Indianapolis, Ind.; Fredk. C. Moore, Hoopeston, Ill.; A. H. Moran, Washington, D. C.; Ernest C. Morris, Washington, D. C.; S. Myers, Brooklyn, N. Y.

Marshall N. Newell, Richmond, Va.; Samuel F. Newman, Waynesboro, Pa.; R. S. Newton, Watertown, N. Y.; John Olbinski, Portsmouth, Va.; P. G. Paris, Bethlehem, Pa.; Peter A. Petroff, New York, N. Y.; George E. Probest, Jr., Baltimore, Md.; Walter R. Prosch, Chicago, Ill.

F. J. Quail, Watertown, N. Y.; John V. W. Reynders, New York, N. Y.; Joseph M. Richardson, Churchland, Va.; B. J. Riggs, East Alton, Ill.; Richard Rimbach, Pittsburgh, Pa.; Kenneth B. Roberts, Fort Wayne, Ind.; Charles B. Roede, Jersey City, N. J.; Harold H. Rugg, Wilkinsburg, Pa.; Wm. F. Sadtler, Portsmouth, Va.; Harry Saxer, Woodlawn, Pa.; Charles Schenck, Bethlehem, Pa.; R. L. Schroeder, Portsmouth, Va.; A. D. Shankland, Bethlehem, Pa.; Alfred Shriver, New York, N. Y.; James A. Slater, Cleveland, Ohio; Elmer A. Sperry, Jr., Brooklyn, N. Y.; A. A. Stevenson, New York, N. Y.; J. H. Stoll, Bethlehem, Pa.; Harry A. Strong, Washington, D. C.; F. A. Sullivan, Bethlehem, Pa.

Geo. H. Tompkins, Watertown, N. Y.; Francis L. Toy, Pittsburgh, Pa.; W. D. Tyler, Watertown, N. Y.; I. C. Vroman, Watertown, N. Y.; Wendell Westover, Schenectady, N. Y.; Fred. A. Weymouth, Peublo, Colo.; Henry P. White, Ithaca, N. Y.; A. A. Whitesell, San Francisco, Calif.; George S. Whyte, Kenosha, Wis.; and Charles Yon, Pittsburgh, Pa.

Sergeant Kemp Commended

THE Assistant Secretary of War, Hon. F. Trubee Davison, has sent the following letter of commendation to Master Sergeant Elmer Kemp, Ordnance Department, at the Wingate Ordnance Depot, Fort Wingate, New Mexico:

"Dear Sergeant Kemp:

"My attention has been called to the report submitted by the Inspector General on his recent survey of the Wingate Ordnance Depot which is commanded by you. The conclusions of the Inspector General are:

" 'The Depot is operated at its maximum efficiency due to the ability, energy and resourcefulness of the Depot Commander.

" 'The improvements made during the past year reflect great credit upon the Depot Commander.'

"I desire to commend you on behalf of the War Department for your excellent administration of the Ordnance Depot and for your tact in handling the many difficult situations which arise at your station.

"As a further token of the appreciation of the War Department, I am pleased to enclose herewith a copy of a letter appointing you as Lieutenant-Colonel, Specialist-Reserve for duty with the Ordnance Department."

Master Sergeant Kemp was born in Willing, New York, December 29, 1884, and has a record of service extending from 1904 when he served as private, corporal, sergeant and first sergeant in the First United States Infantry.

During the World War he served in the grades of first lieutenant, captain, and major. His activities were mainly connected with the Ammunition Service of the Ordnance Department at the Charleston Ordnance Depot. In 1920 he was commissioned a captain of Infantry in the Regular Army and in 1921 voluntarily resigned to accept an appointment as Master Sergeant in the Ordnance Department. He has commanded the Wingate Ordnance Depot since May 15, 1928. Wingate is an important branch depot where thousands of pounds of explosives are stored. In 1921 Master Sergeant Kemp was appointed a major in the Ordnance Reserve.

ARMY ORDNANCE

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Month by Month

The Chief Retires

MR. CROWELL, our President, has expressed elsewhere in this issue his appraisal of the outstanding record of General Williams upon his retirement from active military service. It is permissible, we hope, to express in this place the sentiment of the staff of Army Ordnance and of the national headquarters of the Association. To have had the active support and coöperation of the General since the very first day of the Association's existence was the good fortune of the organization. While entirely aloof from the formulation of its policies, much less the dictation of its activities, he met with sympathetic response every suggestion that emanated from it. His kindly interest and support and his counsel whenever sought—and it was not infrequent—always were freely given.

To him our grateful thanks and good wishes. We hope that his retirement will bring him the rest and relaxation he so richly deserves. To have been associated with him, in even an unofficial way, was a privilege not quickly to be forgotten. His is a name to recall the highest and best in unselfish, efficient public service; his a record to be remembered in military and industrial annals; a doer of deeds, a leader of vision and a man of men long to be cherished with affection and esteem. Health and happiness *ad multos annos.*

Doughboys and Dollars

GEN. HUGH JOHNSON'S article on the proposed universal draft, which was published in the November-December issue of this Journal created not a little discussion among our readers. We are pleased to publish the following letter to the Editor from Lt. Col. George S. Brady, Ord. Res., an active member of the Association:

"For the past several months I have been exceedingly busy, but I always save my Army Ordnance until such time as I get opportunity to read it over. Today in going through the November-December issue I read with interest, but with decided disapproval, the article by General Johnson on the fallacies of 'The Universal Draft.' This article is merely General Johnson's *opinion* of the universal draft, and I can assure you that it is not the opinion of many thousands of others in the United States. I am surprised, therefore, that you have headed it with the positive editorial label 'Fallacies of the Universal Draft.' It gives one the idea that the editor is fully in accord with the ideas expressed.

"Viewing his record, I have great respect for General Johnson's ability, but nevertheless I question from a labor-personnel standpoint the logic of some of his arguments. There is often too great a tendency in dealing with personnel problems to argue by the elimination or ignoring of factors unfavorable to the point desired to be proved.

"I do not question the great difficulties in the way of a universal draft of manpower. Many manufacturers do not want it for obvious reasons. Labor unions are afraid that it will open a way to the destruction of union operation. Yet the American Legion has approved it in principle, and a surprising number of independent thinkers feel that when the next war comes some form of universal draft will be adopted because of the obvious injustices in the former selective draft. In just what it will consist would be impossible to say now.

"But, as soldiers we should face the facts squarely. A lawyer, to win a case, may feel justified in bringing out the condemnatory arguments and hiding the favorable ones, but will that get the soldier anywhere?

"Why should General Johnson quote constitutional rights for the worker left at home and not for the soldier in the trenches? I think that I can quote from any authority to the effect that republics do not function as such during wartime, and that no constitutional rights considered as detrimental to the cause at issue are permitted to exist. General Johnson says that, if positive control were exerted over the worker, he would be a slave. He says that the soldier's entry is not contractual. Certainly, a general in the Army does not believe that play on words!

"Under the selective service conditions of the World War the man between 21 and 31 had no free power to come and go at will. The selective draft said to the right-living and healthy man: 'Come where I bid and receive $1 a day minus insurance and other items.' To the incapable man in the draft age it said: 'Stay in the munition plants eight hours for $10 a day and have absolute freedom otherwise.' There was nothing in the legal 'contractual' sense with the soldier because his freedom was taken completely and absolutely—his right of free speech and his right of trial by jury. In some cases he volunteered for patriotic reasons, but if he didn't he was forced. Why say that the placement of some of these uniformed men into industries would be 'chain-gang or impressment?'

"After all, when the subject is analyzed it comes down to a matter of more equal distribution of wages and profits during a war. Most real citizens in the military age want to serve in the active forces and are willing to suffer the deprivations and the dangers. But while serving in the trenches they do not like to receive letters from their families, who are struggling to exist on a soldiers' allotment, to the effect that John Smith and John Jones, the town bums, are getting ten dollars a day in the munition factories. The case of the late Judge Gary was not pertinent to the subject. Nobody, not the wildest advocate of universal draft, wants to remove managers of manufacturing plants away from their jobs in wartime. That may be socialism or communism, but it is not the universal draft idea, and should not be brought in to confuse the issue.

"The profits of industry during wartime is yet another question, important, but not the same as this question of universal draft. Why bring it in with its arguments about excess-profits taxes, whole families on the pay rolls, and other things that are not at all pertinent?

"One question not touched upon by General Johnson was the matter of a universal old-age pension that would be the survival of a war where the universal labor draft was in force. Such a pension would be of incalculable benefit to the country as a whole, and would be an answer to many social problems of today, among which is the argument of the socialist that 'In wartime the State reaches out an iron hand to commandeer the manpower which it claims as its own to defend its very existence; but in peace time it does not guaranty to this manpower the work and wages that will assure healthy bodies and moral communities.'"

Sincerely yours,

GEORGE S. BRADY,
Lt. Col., Ord. R. C.

From Colonel Brady's view of the inequalities of personal service in war few will dissent although they may rightly concur in General Johnson's thesis on this point. So far as we have been able to learn, however, advocates of a universal draft mean exactly what that term expresses, a draft of capital and labor, of facilities and supplies, of men and material. Indeed, we should be grateful to see the so-called universal draft reduced by its proponents to simple and definite terms particularly as to the methods to be followed in applying it. So long as the cry is raised to draft this, that and the other when the obvious difficulties, if not absurdities, are so apparent, then, in our opinion, one can only apply to shibboleths the yardstick of practicality.

By all reasonable means let us endeavor to remove the inequalities of remuneration for personal service in war. On the more fundamental economic considerations, which Colonel Brady has touched on only lightly, let us make haste slowly remembering always that our industrial structure is far too delicate an organism to be governed by snap decisions put out for the delectation of the man in the street.

The discussion will have advanced immeasurably when advocates of a universal draft state in definite terms just how it will operate in fact. Until then such opinions as those advanced by the large group, of which General Johnson is one, and by the perhaps larger group, of which Colonel Brady is representative, can be stated only in general terms. As an aid to an equitable solution both have performed a service in stating their beliefs. We trust that other qualified readers will contribute their views for publication in these pages. Constructive debate is a potent vehicle for sound conclusions.

More Theories of Can't

THE philosophy of "don't" and theology of "can't" had another chapter added to their growing kilologue with the recent introduction in the Legislature of Massachusetts of a bill prohibiting the "manufacture, sale, transportation or delivery of pistols, revolvers and certain other firearms except in certain cases." The bill introduced by Mr. James J. Twohig of Boston provides for the amendment of Chapter 269 of the General Laws of Massachusetts by the addition of the following new section, "Section 14. Whoever manufactures, sells, transfers or delivers a revolver, pistol or other firearm which may be concealed about the person, or any part of such firearm, shall be punished by imprisonment in the state prison for not more than five years or by a fine of not more than ten thousand dollars, or both. Nothing in this section shall prohibit the manufacture of such firearms and the sale thereof by the manufacturer to police and other governmental departments, and such firearms possessed or used contrary to the provisions of this section and wherever found shall be seized by any police officer and thereafter destroyed." The bill, if enacted, is to become effective January 1, 1931.

The old case of the cart before the horse: because some abuse a right deny it to all! Not content with salutary regulations affecting the carrying of concealed weapons, some of our zealous legislators would prohibit the manufacture of pistols and revolvers except for the use of the police and other governmental agencies. Aside from the infringement upon the law-abiding householder who must procure a broomstick or brickbat to ward off the automatic-armed intruder, there are vitally important reasons against the enactment of such legislation. A case in point is that of the Smith and Wesson Company, one of the few commercial manufacturers of pistols in America. With such legislation operative in Massachusetts that company and others of their small confraternity would have to nail up the shutters. The consequences of such action are referred to in the following letter sent the company by the Secretary of War:

"The War Department is naturally hesitant to express its views on any matter which is apparently the sole concern of one of the several States, and believes it is not justified in doing so unless the matter in question has some direct bearing on the common problem of national defense.

"In this case the War Department's concern arises from the fact that under the law it is charged with the 'assurance of adequate provision for the mobilization of material and industrial organization essential to war-time needs.' Since in any future emergency the Nation would be absolutely dependent upon private industry for 90 per cent of the pistols and revolvers necessary to maintain our forces, it is essential in the interests of national defense that existing establishments for the manufacture of these weapons remain in being. On the other hand, the War Department is in entire accord with the efforts being made to prevent the acquisition of firearms by our criminal classes, but trusts that the various legislative bodies will find a way to accomplish this without lessening the ability of the country properly to arm its citizens in case we are forced into a war.

"In short, the department would like to conform its policies to the best thought on the subject, consistent, of course, with the recognized necessity for the use of such arms in the event of a national emergency."

If the measure becomes law the Commonwealth of Massachusetts, in truth, will have killed two birds with one stone: it will have hindered the law-abiding citizen in protecting his life and property against the law-breaking intruder and it will have dealt a serious blow to the national defense. Meanwhile, the criminal-minded will continue to supply themselves with their needed armament in abundance whether bearing the imprint "made in Massachusetts" or

not. The good effects of such legislation weighed against the bad should not, in our judgment, leave the Bay State legislators much choice as to what to do in the matter.

Echoes of the Long-Range Gun

APROPOS the review of Colonel Miller's book on the German long-range guns used in the bombardment of Paris, Col. Leonard P. Ayres, Vice-President, Cleveland Trust Company, and organizer of the statistical units of the War Department and the A. E. F. during the World War, has revealed the role of the statistician in diagnosing the probability of duds from those monster weapons.

In a recent address before the officers of the Army Industrial College, Colonel Ayers said:

"One very disagreeable, rainy night not long after our arrival (in France), the Adjutant General in person came to my billet and gave me orders to report at Versailles at daybreak the next morning. It was a long way from Chaumont and the orders were imperative, but blind, of course. It seemed to me it must be something very important that the Supreme War Council wanted so I gathered such material as I thought might be useful, rode all night and got there the next morning. I was met by an American officer who explained what the mission was. He said they had gathered there the artillery ordnance officers selected from all the Allied armies because of their knowledge of artillery and had constituted them a board under orders to wait until there was a dud from Big Bertha and to draw up plans and specifications for artillery like Big Bertha so the Allies might begin its manufacture. At that time Paris was under continual 20-minute bombardment and the Board had been sitting a long time. Somebody had told them there was a statistical officer at Chaumont and if they would send for him he could compute how long the Board would have to wait before there would be a dud. All of you have probably had some experience in computation and you will recall that it is not possible to compute the probability of an occurrence of which there has never been a single instance. However, that was the first time the Statistics Unit had been called upon to do anything for the Supreme War Council, and it was the only military statistics unit in the Army, although now I believe all armies have such units. I asked them if they had any samples of Big Bertha's shells. They had a large table there entirely covered with portions of those shells. There was an order that when a shell fell its pieces should be recovered and turned in, with a report as to the hour and place it fell. These pieces ranged from the size of a half dollar to a whole side of one of the shells. Looking over these and wondering what I was going to say, I noticed some fragments of fuzes and I asked if each shell had a single fuze or two or more fuzes. Some of you who have brushed up against the theory of probabilities will realize that what I was groping for was an independent cause and it took a long time to decide that they had two independent fuzes. I had thought that would be the case. Then I asked if they could tell by further examination whether the two fuzes came from the same manufacturer or arsenal, or whether they originated in different manufacturing plants. That took well into the next day when they reported that it was pretty clearly evident that each shell had two fuzes and they came from two arsenals. Then I asked them if they had tables showing the number of duds found in ordinary shells carrying these fuzes. They had. I was then able to make a statistical reply. In any problem of probabilities, when you are dealing with perfectly independent causes, the probability of such a result as we are considering would be not in proportion to adding the probabilities, but in porportion to multiplying them. So if you had one fuze that would produce one dud in 1,000 shots and you had another fuze not likely to contain some defect, this probability was also one in 1,000, and the probability that both would fail at the same time was not one in 2,000 but one in a million. So I told them that there was not going to be any dud in that war. I took a chance on that because even if there was going to be only one in ten years it might happen to be the next day. However, I did not explain that. I thought that, coming from the Statistical Unit, the answer had better be definite. The war ended without there being a dud from Big Bertha."

Colonel Miller, who is the recipient of many justly deserved compliments on his recent book, is an engineer of international reputation. Since 1922 he has been the dean of Army Officers attending the Massachusetts Institute of Technology and a member of the faculty of the Ordnance School at Watertown Arsenal. He was a teacher of mechanical engineering from 1886 to 1893 and has served at Tech as professor of steam engineering since 1892 and in charge of the department of mechanical engineering since 1911. He served in highly important capacities in the Ordnance Department during the World War and is the author of several authoritative texts on artillery matériel.

Upon the occasion of his 64th birthday in January last and his transfer to the Auxiliary Reserve of the Ordnance Department, Maj. Gen. C. C. Williams, Chief of Ordnance, sent a letter of felicitation in which he said, "I wish to take this opportunity to express to you my appreciation of the splendid work you have done for the Ordnance Department not only during the war but since. Your personal interest and influence have done much to place the Ordnance School where it is today; and the value of your advice in engineering matters, I would not even attempt to estimate. That we will continue to have the benefit of your advice and counsel for many years to come is my sincerest wish."

Colonel Miller is a director and past-president of the Boston Post, Army Ordnance Association. ARMY ORDNANCE joins in congratulations on a life of real accomplishment, the latest evidence of which is his unusual book, "The Paris Gun."

Milwaukee Sets the Pace

AT the annual meeting of the officers and directors of the Association plans were approved for increasing membership. All of the local posts of the organization have been asked to appoint committees on membership and they are coöperating in splendid fashion. The Milwaukee Post, under the leadership of Col. W. W. Coleman, President of the Post and a Vice-President of the national Association, has an active committee in operation with Lt. Col. J. G. Cowling as chairman and Maj. Roger Sherman Hoar and Maj. A. G. Peter, members. Indications are that Milwaukee soon will add to its list of causes of fame. The committee is covering the ground in a very systematic way.

In this connection we would like to elaborate on the subject to the edification of our members. The Association, despite its restricted field, should have a larger membership. The importance of its activities warrant that. There are a great many men who should be familiar with its work who have no idea that an organization with such functions is in existence. One way to inform them would be through a campaign on a large scale with its attendant disadvantage of enlisting quantity rather than quality. Another, and the more enduring method, is through personal contact among friends and acquaintances or by the recommendation to National Headquarters of names of qualified persons who should be familiar with munitions developments. Thus the post activities toward larger membership are an unostentatious but logical means of action.

The membership of the Association, 3456 on February 28, 1930, was the largest in its history. As that figure rises so does the value and effectiveness of the organization. Milwaukee is blazing a trail. We hope all others—individually and collectively—will lend a hand. The office of the Secretary will do everything possible to coöperate.

New Methods Supplant the Old

THAT munitions making is keeping abreast of current commercial practice is again made evident by the application of welding to ordnance production. The progress reported by the Watertown Arsenal in this important field is a tribute at once to the personnel of that establishment and to the policies of the Ordnance Department. Industry and munitions going hand in hand is the logical—indeed, the only—road to sure advancement.

When the Army can learn from industry the duty is compelling that it apply to the best advantage the principles acquired. The reverse has been true to the advantage of industry. Writers and speakers are prone to stress the pioneering of the Army in scientific fields. In much of their encomium too little emphasis has been placed on what ordnance development has done in the applied sciences. We venture to say, based only on a general resumé of the matter, that the scientific development of the metallurgy of weapons has contributed more toward the present state of metallurgical development generally than any other single influence. The same is true, possibly in a more limited degree, in the field of chemistry.

The purpose of the comparison is not to "credit here and debit there." But rather to stress the relationship between the two spheres, the military and the industrial. As commercial quantity production, particularly in the automotive field, has brought improved technique, the munitions designer should be among the first to apply to his problems the best related practice. Conversely, the ingenuity of the ordnance expert should find valuable application to the problems of industry. That some stargazer has visions of a weapon to shoot to the moon may mean only that there is enough practical novelty in his invention to add a yard to the range of a gun. That some star-gauger has premonitions of a device to improve the cylinder walls of an automobile engine may imply miles to the average life of an automobile. The fact remains that had gazer and gauger, figuratively speaking, stuck too close to their tasks progress in both respects would not have been what it has.

Sermonette

CONGRESSMAN ROSS A. COLLINS, of Mississippi, member of the War Department Sub-Committee of the House Committee on Appropriations, delights every now and then in taking a wallop at industrial preparedness. It is his privilege, of course, to be against or in favor of anything he chooses. However, in expressing his opinion such of it as is based on fact should be accurate and not mythical. Here is what Mr. Collins had to say about procurement planning for war:

"The most dangerous of all the proposals and the most unnecessary is the placing of Army officers in the cities of our country for the purpose of keeping in touch with the factories, farms and transportation systems so that in the event of war or emergency *they can take over and operate them.* (Italics ours.) This work is called procurement. There are quite a number of Army officers engaged in this work now, and every year it has been proposed to increase the number. There is no good reason for this activity at all; certainly not for its expansion.

"The civilian population of the country is equally patriotic with the military and naval establishments, and certainly they can be trusted to operate strictly civilian activities conscientiously and without the aid of the military. They know their work better than any one else and should be permitted to pursue it without the meddling of outsiders."

To which Congressman Taber, of New York, replied:

"I want to call the attention of the House to one other thing and that is the procurement planning proposition.

"This is being carried on in a moderate way under the Assistant Secretary of War. *It is not a scheme to place Army officers at the head of factories.* (Italics ours.) Nobody ever thought of such a thing. Congress never thought of such a thing, and it is not provided in the national defense act. It is simply a program by means of which executive officers in the War Department with business training can find out and know in what factories they could place orders, either for munitions of war or for other war supplies in case of an emergency. *It is not a scheme by which the Government would take over the management of the factories over the heads of trained factory managers* (italics ours), but simply that they might know where they can promptly and efficiently place orders and procure prompt execution of these orders and thus avoid the tremendous delay which took place at the time this country went into the Great War in 1917.

"It is a constructive measure and not a foolish one. It is true that it must be held down. It is true that it must not be allowed to run wild and result in foolish expenditure of money, but within reason and within common sense it is an activity which in case of emergency would be found of real value to the Government."

The gentleman from New York stated the fact and upon it bases a sound conclusion; his colleague from Mississippi stated a fancy and upon it rears a scarecrow.

The good-natured Mr. Collins seems to take great delight in stating, over and over again, his incorrectly understood view of industrial preparedness. This time he goes one better in referring to Army officers running the farms in war. Shame on them that they should try to pitch hay as well as a farmerette!

Common Sense in National Defense

An Editorial

MR. ERNEST T. TRIGG, Chairman of the Committee on National Defense, Chamber of Commerce of the United States, and a Vice-President of the Philadelphia Post, Army Ordnance Association, has a very timely and level-headed article under the above title in the March issue of *The Nation's Business*. Predicating his views on the granted premise that the essential goal of national defense is national security, he points out that people generally agree as to that but disagree as to the means of obtaining it. On the one hand are the officers of the Army and Navy who urge the necessity of efficient combatant forces "sufficient at least to ward off an attack of the strongest possible hostile combination until additional defenses can be built up." On the other are "our civilian statesmen who check these proposals of the professionals and experts as against the ability of the taxpayer to pay for them and as against the ability of the diplomacy of the country to reduce the hazards of war." Under such conditions, Mr. Trigg points out two errors which must be avoided: the one that diplomacy is the only morally justifiable means of national defense—the position of the extreme pacifists, and the other that this medium can do little or nothing to reduce the hazards of war. "If we free ourselves of these two errors in our thinking," writes Mr. Trigg, "then it seems to me that a common-sense approach to national defense will attempt to balance diplomatic measures with military measures and thus aim to obtain for our country at any given time a maximum of security. These two approaches are not antagonistic. Rightly understood they are supplementary."

A COMMON-SENSE approach to national defense! Would that it might be emblazoned everywhere that all might adopt it as an article of faith! That the peace-at-any-price advocate might, according to it, temper his extremist viewpoint with the alloy of reason and experience! That the "big-navy boys" and the folks of both sexes who always are whooping up things might back down to the stage of moderation. That the groups at both ends of the national defense spectrum—the blushing violets and the rabid reds—might come together in the white light of common sense.

Mr. Trigg concludes his discussion by saying, "The great bulk of our people are neither militarists nor pacifists—using those two terms to label the extremists. They are sensibly interested in practical measures for bettering the relations between nations and in practical measures for assuring adequate preparedness to meet an emergency which might arise. A concrete indication of this is the recent action of the business men of the country, as represented by the Chamber of Commerce of the United States, in adopting a resolution favoring 'educational orders' as an important method for perfecting our planning for industrial preparedness, and a resolution approving the principles of the Kellogg Peace Pact. These two positions are supplementary. They reflect a common-sense viewpoint of national defense."

We wish that that "great bulk," to which Mr. Trigg refers, were even more intimately appraised of the sensible policy which governs in this country. As it is, they seem to think as they do from an intuitive sense. Psychologists may lay it to patriotism; anthropologists to the will to survive; psychoanalysts to fear. But that matters little. The thing is that, in the main, we are sensible. We cannot but believe, however, that that great bulk would be even bulkier were their conclusion based on a better knowledge of our national defense system, particularly in those phases connected with industrial preparedness.

HOW many of our people—those of the common-sense viewpoint—are familiar with industrial preparedness and its meaning? How many understand its reasonableness, its fairness, its actual importance in peace and its greater meaning in war? How many actually know of the salutary things that are being done and of the others, equally salutary and vital, that are left undone simply because of their unfamiliarity? We believe they are relatively a very few of our one hundred and twenty millions.

Recently we unintentionally overheard a conversation of two patrons of a large Metropolitan moving picture theatre. They had seen in a newsreel some of the demonstrations at the Aberdeen Proving Ground incident to the last annual meeting of the Army Ordnance Association. "I had no idea," remarked taxpayer A, "that we had such guns." "Neither had I," replied taxpayer B. "We're O. K. as long as we have them babies." True enough, Mr. Taxpayer, who, obviously, is one of our great bulk of common-sense addicts. But he should know that the weapon whose prowess he admired was a very recent development and that we had, at most, a half dozen of them. He should know that at the present rate of going it will be years and years before enough of them will be available for him to justify that spontaneous O. K. He should know, too, that if war came the arsenals of his country could produce a mere ten per cent of all munitions requirements for a major war and therefore that industry, possibly including the very plant in which he guides a lathe or punches out convention badges, must "click" on producing, without delay in time and waste of material, the other ninety per cent. He should know of the splendid work of Mr. Trigg's Committee which sponsored educational orders to enable those plants, in piecemeal fashion, to try their hand at the job the better to do it if war actually comes. He should know of the sanity of the whole plan and the common sense of the thing would give his O. K. even firmer conviction. But most probably he doesn't. Credit him meanwhile for his sound reasoning and slap ourselves on our collective backs that his good judgment and that of millions like him—unfamiliar though they be with the machinery of national defense—are for the middle ground of procedure. Congratulate the Nation that it has a bulk of common sense which coöperates for peace at all times and, simultaneously, insists on a reasonable tincture of preparedness in the medicine of defense should some unwelcome doctor prescribe its use.

Professional Notes

Invesigation to Determine the Possibility of Creep in Primers

THE question of so called creep in primers has recently received the attention of the primer section of the Technical Division at Picatinny Arsenal because of the fact that the 37-mm. automatic gun developed by the Colt Company has a sliding breech block, and protruding primers would seriously interfere with the working mechanisms of the gun as well as present a possibility of prematures in the event of the sliding block catching a protruding primer. For many years there has been a feeling among personnel engaged in the loading and assembly of primers that, due to the interference of metal in the force fits, either the primer cup might be expected occasionally to creep out of the primer body or the primer body creep out of the cartridge case.

Due to the rather serious condition presented by protruding primers in ammunition which would be used in guns with sliding breech blocks, it was decided to conduct a very thorough test to determine whether primers did creep after loading, and if so to investigate the reasons for the movement. In conducting the test it was decided to investigate the 20 grain M3 percussion primer loaded in the 37-mm. antiaircraft cartridge cases, Model E3 and the same primer loaded in the 1.457 subcaliber cartridge case. It should be noted that the length of the primer seat in the 37-mm. antiaircraft case is approximately ¼-inch, whereas the seat in the 1.457 case is longer due to a boss inside the base.

An examination of the 20 grain M3 primer bodies in stores disclosed the fact that the outside diameter of the primer body was not uniform between the flange and the bridge on which the cap rests, the diameter at the bride being from .0005 to .001-inch larger than the diameter under the flange. This variation is incident to good drawing practice. However, the cartridge case seat being considerably harder than the primer body it was thought this condition might result in line interference of metal instead of surface interference as intended by the designer with the result of a possible rocking action. In the investigation it was proposed to use some of the slightly bulged primers and others which had been carefully resized to give the desired surface interference of metal.

The tolerance of the primer recess in the cartridge case and the tolerance of the primer body permit a minimum interference of metal of .001-inch and a maximum interference of .005-inch. The tolerance of the primer body and cup permit a minimum metal-to-metal fit and a maximum interference of .003-inch. To meet all possible conditions of interference of metal that could arise with the specified tolerances, six each of the following 37-mm. antiaircraft cartridge cases, Model E3, using 20 grain primers, were assembled: (a) M3 primers slightly bulged, from present lot in stores; (b) M3 primers resized to give interference of .006-inch; (c) M3, .005-inch interference; (d) M3, .004-inch; (e) M3, .003-inch; (f) M3, .002-inch; (g) M3, .001-inch; (h) M2 primers from stores; and (i) 1.457 subcaliber cases using 20 grain M3 primers from present lot in stores.

In each of the above nine groups, selective assembly was employed in assembling the cups in the primer bodies so as to give all possible interferences of metal between cup and primer body. The Mark II primers were used in one group because they had a slightly different contour of body.

After the various groups had been determined by selective assembly the primers were loaded in the cartridge cases using production tools and similar loading methods as those employed on production orders. The cartridge case contained the standard powder charge and the shell was loaded inert. After loading, each round in the various groups was carefully gaged to determine the distance between the base of the cartridge case and flange of primer and also between base of cartridge case and cup in primer. The rounds were then allowed to stand for approximately 24 hours and again the same points were gaged.

The rounds were next loaded in three standard packing boxes and transported by arsenal truck for seven days after which the three boxes were placed in a truck making one of the regular trips to the Aberdeen Proving Ground. On this journey one box was placed right side up, one box on edge and one box upside-down. At the end of each day of the arsenal transportation and on the return from the proving ground the above mentioned points were carefully gaged.

A careful inspection at the end of each day of the ar enal transportation test and after the transportation to Aberdeen Proving Ground disclosed the fact that there was absolutely no movement of either primer in the cartridge case or cup in the primer body in any of the rounds of the above mentioned groups.

As a result of this investigation it is concluded that: provided the dimensions affecting interference of metal of the primer recess in the cartridge case and those of the primer bodies and cups are within the tolerances specified on the drawings, there will be no movement of either the primer body in the cartridge case or the cup in the primer body.

L. J. DILLON,
Captain, Ordnance Dept., U. S. A.
Picatinny Arsenal.

16-Inch Gun Target Practice

IN furtherance of perfecting proper methods for conducting long-range firing the Secretary of War has recently directed the Commanding General, Panama Canal Department to carry out, during the months of May and June, extensive firings at moving targets at extreme long ranges with modern 16-inch guns. With the increase in both the caliber and the elevation given to guns on the modern battleship it is possible for navies of the world to bombard coast defenses at much longer ranges than heretofore. In answer to this challenge of modern battleships to the coast defense guns, the United States has, since the World War, installed 16-inch guns capable of firing well beyond 40,000 yards, for the protection of the Panama Canal.

Up to date no firings at ranges beyond 30,000 yards have been conducted by the Coast Artillery due to the difficulties of terrestrial observation. With the development of the

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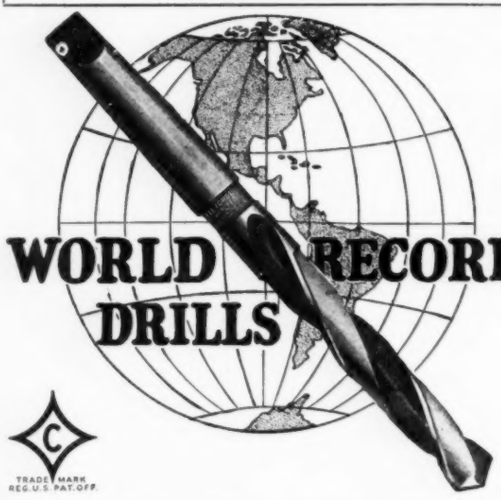

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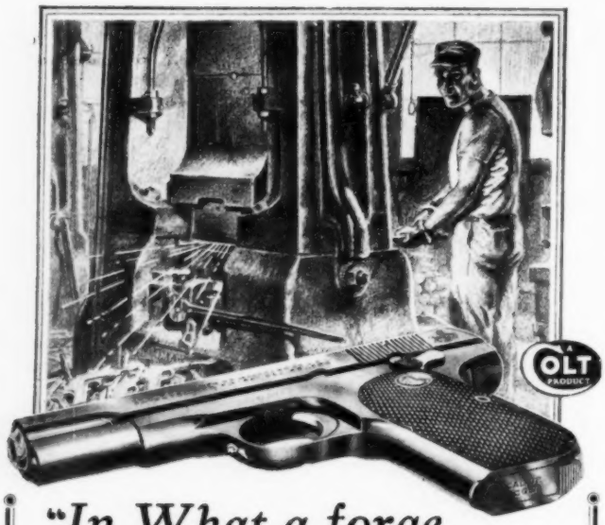

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airplane it has now become possible to control the fire of these guns at distances never before dreamed of.

An extensive program for the firings has been furnished by the Chief of Coast Artillery to the authorities in Panama. This program provides for not only controlling the actual firing of the guns at the target, but also the indication of where the target is to the battery ashore by the observer in the plane. The observer will have to do this without approaching near enough the target to be within the range of the antiaircraft guns on the ship.

Reorganization of Field Artillery

MOVED by the desire to get the greatest value per dollar the Secretary of War has directed a reorganization of the Field Artillery at the earliest practicable date. This step will be felt by practically every regiment of Field Artillery in the United States, although only a few localities will benefit by receiving new organizations.

The decision to effect these sweeping changes, the most drastic since the World War, is the result of intensive studies by the General Staff and the Chief of Field Artillery, in which every endeavor was made to increase the efficiency of the Field Artillery and to place its units where they would be of most use and assistance in training the National Guard and Organized Reserves. At the same time it was desired to utilize to the maximum all permanent quarters, as many of the cantonments built during the war have become uninhabitable.

The localities benefitted the most by this reorganization will be Fort Ethan Allen, Vermont, Fort Leavenworth, Kansas, and Fort Lewis, Washington, each of which will be the home station of a new battalion of 155 howitzers, the big brother of the 75-mm. gun which fought hub to hub during the World War. A regiment of 155 howitzers is now a part of the Field Artillery brigade of the infantry division. The only 155 howitzer regiment in the country was formerly at Fort Bragg, North Carolina. Under the new arrangement many more reserve officers will have opportunity to train with these howitzers.

With economy always in mind it was decided to sacrifice certain organizations to supply these new units, hence, in a short time headquarters and service batteries of the 3rd Field Artillery at Ford Sheridan, Ill., of the 5th Field Artillery at Fort Bragg, will case their regimental colors decorated as they are with battle honors dating back to the War of 1812, in the case of the Third, while the "Fighting Fifth" wears with pride streamers won by service at Manassas, Antietam, Chancellorsville, Gettysburg, Lorraine, Picardy, Mondidier, Noyon, Aisne-Marne, St. Mihiel and Meuse-Argonne.

Three ammunition trains and 14 batteries whose strength had been so reduced in order to build up our Air Corps that they were unable to function as batteries were also made inactive.

New Method of Spotting Antiaircraft Fire

MOTION pictures of shells bursting about an aerial target are utilized in a spotting device recently developed by Capt. A. M. Jackson, Coast Artillery Corps. From the pictures the antiaircraft gunners are able to tell accurately whether their shots were close enough to spray the enemy plane with shrapnel or fragments of high explosive.

The "cinematic spotter" employs two motion picture cameras, one at the battery position and another a measured distance away on a flank. The cameras are synchronized by means of an electric timing arrangement. They replace the present observers, who experience great difficulty in locating all bursts due to the speed of modern antiaircraft fire, which reaches 100 shots per minute for a battery of four guns.

To assist him in the development of the cinematic spotter, Captain Jackson last year took a special course in opties at the University of Paris. On his return he supervised the manufacture of the present model of the device at Frankford Arsenal. It will be given an extensive test at Fort Monroe, Virginia, under the auspices of the Coast Artillery Board.

Organization of New Antiaircraft Regiment

THE needs of national defense in the matter of additional protection against air attack have prompted the formation of a new antiaircraft regiment known as the 69th Coast Artillery which is now being organized at Aberdeen Proving Ground, Maryland.

Regular troops made available by the recent reorganization of the Coast Artillery Corps will make up the personnel of the new unit, the principal contingents coming from the Harbor Defenses of Boston, Narragansett Bay, and Sandy Hook, and from the 1st Sound Ranging Battery.

The new regiment is of a composite type, consisting of a band, combined headquarters battery and combat train, a searchlight battery, a 3-inch gun battery and a machine gun battery, totaling approximately 16 officers and 330 enlisted men.

The equipment will include the latest type 60-inch searchlights, 3-inch mobile antiaircraft guns, and both caliber .50 and caliber .30 antiaircraft machine guns, as well as the most modern fire-control instruments. The searchlights are carried in Cadillac trucks, and the 3-inch guns are on wheeled mounts fitted with pneumatic tires. As motor vehicles are to be provided for transporting all other equipment and the personnel, the regiment will be a highly mobile unit.

Aberdeen Proving Ground was selected for the organization of the new regiment because of the favorable location of that station for purposes of assembling the personnel and equipment and because of the opportunities for training afforded by the antiaircraft firing tests held there each year.

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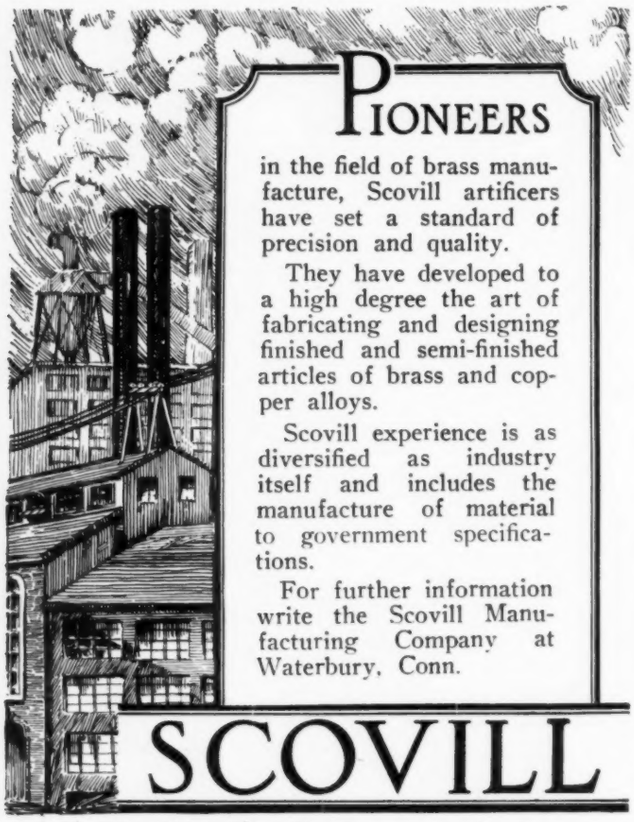
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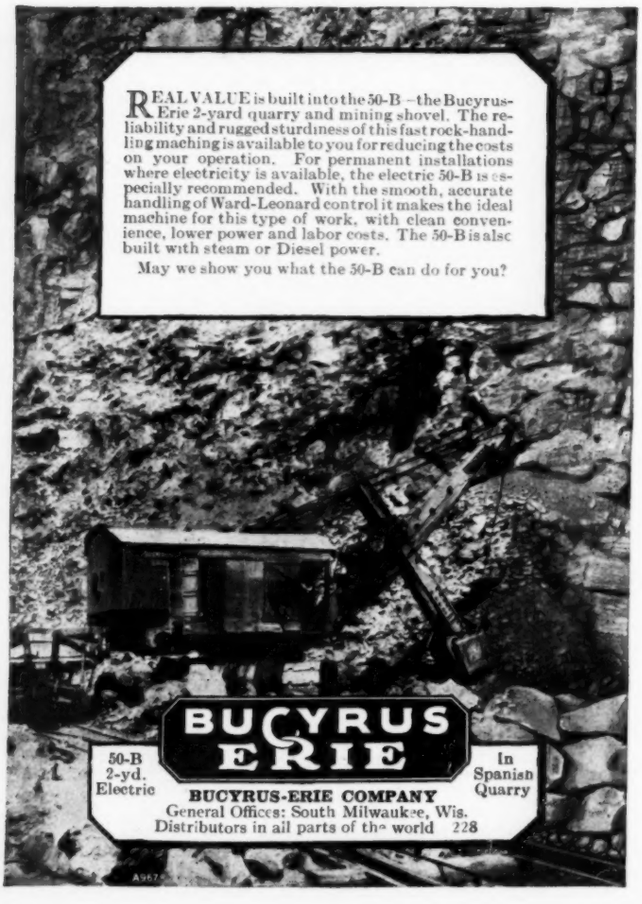
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Patents

THE following resume of recently granted patents relating to aircraft armament was prepared by Mr. W. N. Roach, Chief, Patent Branch, Ordnance Department:

Christian Pfeiffer and Frederick T. Moore, assignors to Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., have been granted Patent No. 1,719,126 for a magazine feed mechanism for machine guns. This magazine is of the type which is positioned above the gun and has a central depression therein to allow sighting of the gun and is provided with manually operable means for initially feeding the cartridge belt into the feedway of the gun.

George H. Tansley, assignor to Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., Patent No. 1,719,147 for magazine feed mechanism for machine guns. This magazine is one that is mounted wholly to one side of the gun and has specific means for initially feeding the cartridge belt into the feedway of the gun.

Maj. James L. Hatcher, Ord. Dept., U. S. Army, Patent No. 1,722,629 for a combination mount for machine guns. This mount is one in which the machine gun may be mounted in the usual way for ground fire and may quickly and easily shift to a rearward position for elevated fire against aircraft.

Maj. Samuel G. Green, Ord. Res., Office of the Chief of Ordnance, Patent No. 1,735,164 for a recoil mount for guns. The principal object of this invention is to provide a recoiling cradle for mounting rapid-fire weapons such as machine guns.

Capt. Richard C. Coupland, Ord. Dept., U. S. Army, Patent No. 1,739,125 for a pedestal mount for aircraft guns. The mount consists of a fixed pedestal carrying an adjustable gun-supporting standard connected to an equilibrator enclosed in the pedestal.

William R. Bluehdorn, Office of the Chief of Ordnance, Patent No. 1,738,751 for an automatic pistol. The main object of the invention is to provide in the Colt automatic pistol means for checking the force of recoil and counter-recoil.

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Books

The Generalship of Ulysses S. Grant. By Col. J. F. C. Fuller. New York: Dodd, Mead & Co.

COLONEL FULLER, familiarly known to his family and his fellow officers as "Boney," has listened for many years to lectures at the staff college and has read many pamphlets and books extolling the leaders of the defeated side of our Civil War. Henderson extolled "Stonewall" Jackson as the master leader of cavalry. Maurice pictured Robert E. Lee as the great tactician and strategist. Too much, Fuller fears, has been said of the vanquished and too little of the victor for, after all, winning the war is—or should be—the primary object of the supreme military leaders. Postponing defeat is at best a hopeless task, unless some great advantage is around the corner for him who can endure long enough to gain it.

History has a way somehow of throwing a glamor of romance about the leader of a "lost cause." There is something splendid about that tall gray-clad figure of Lee, even as he stands beside the white flag of truce at Appomatox, asking for the terms upon which he may give up his surrounded army. Fuller finds something even more inspiring in the picture of that magnanimous victor with the black cigar and the old blue uniform, who could say to his fallen foe in the hour of his greatest triumph, "You may keep your swords" and "Let your men keep their horses for the summer's plowing." Was ever a war ended with so little hatred or so great a confidence that lasting peace had come? Fuller has dedicated his book to the youth of America. I hope in this day of much theory, smart talk and high speed, the youth of this country may find time to read it, for within its covers Fuller has lived with Grant through all the intrigues, the bitter denunciaions, the failures, and the noisy clamor of his people, has observed his calmness, his singleness of purpose and his growth of knowledge which in the end gave him the crown of victory. Our psychologists speak so often of the "will to win." If such a will is anything other than tenacity of purpose and hard work, then Grant had it, but I suspect that these things are one and the same.

Grant's story in this book begins when he leaves the leather business in Galena, Ill., to take command of an enthusiastic local regiment. After the patriotic orators finish their exhortations, the regiment loudly calls for Grant, who mounts the rostrum and commands, "Go to your quarters." Hard-boiled, I suppose, we would call him, but when his friend, McPherson, was killed, he went to his tent and wept.

Fuller analyzes Grant's mistakes before the battles of Forts Henry and Donaldson, before the siege of Vicksburg, at Chattanooga, and around this western theater of war; shows how he learned something from each failure and from each success; misinterpreted at times in a very human way the results which he obtained, but restudied such cases to build up his own theory and practice for the particular

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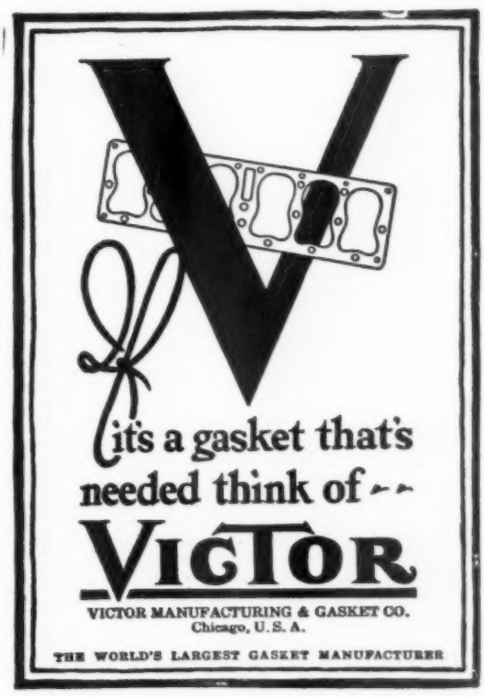
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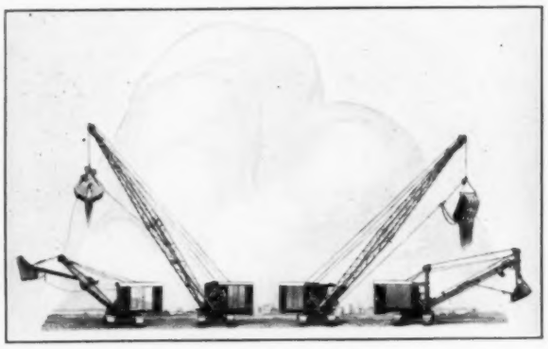

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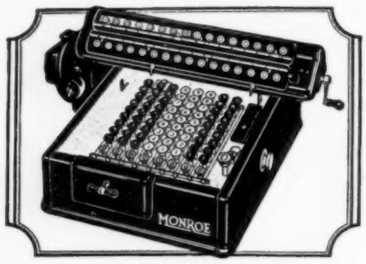

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problem given to him for solution, and after three years of such intensive self-training came on to Washington to solve the major problem of winning a lasting peace.

Many military writers have commented upon Grant's movements of troops, his changes of base, his delays, his wastefulness of troops in assaults, his daring execution of well laid plans, his handling of emergency situations, and his final entrapping of the army of Virginia. Fuller sheds new light on many of these things, gives new reasons for Grant's decisions, offers a new appreciation of his practice of war which fits into theories we have since evolved. Grant could never have covered all the ideas which have been placed into his head since Appomatox, nor could he have remembered himself all the things that must have passed through his brain during that long trip from the Rapidan to Petersburg. His actions, however, must have been based on some such reasoning as Fuller attributes to him, and this reasoning is different from that given by other authors.

After it is all over, Fuller sizes up his hero as a politician, a citizen and a man, as well as a strategist and a tactician. Grant is Fuller's type of a general who ought to lead armies, not because he admires Grant's dress, his voice, his writing, or his cigars—for I am sure each of these would be distasteful to Fuller—but rather because Grant was not governed by that fixed past which had another landscape, other tools and other men, nor by those rigid rules which the old teachers had written for him to learn at school; but because he used good common sense all the time and applied it to each situation, and because he stuck to the main issue, letting the little unimportant things pass by. Grant's methods when applied to the World War show how differently he might have solved many phases of it, and yet these methods were not enough, for new weapons had come to change the character of war. The World War is not enough for us either, who see still newer weapons with which to plan a fight.

The winner is the one who studies, trains himself, uses the old for what it is worth, but uses the new to his high advantage, with that precious common sense so needed for every military situation in peace or war. But even with all that, there is something else required of the great leader, something in his personality which makes men follow him, work for him, and in battle throw life itself away that he may win. His very voice of command expresses this something, his presence makes it felt. The tired soldier responds with a new effort. The spirit of the whole command changes when he comes.

When the team is losing on the football field a new quarterback comes in, sounds victory in his voice as he gives the signals, and the game is transformed. The old weary team snaps into the fight as if by magic, and adds yards to the gain where inches were made before. It is the same with leaders of the battle. Some have it, some do not. Grant did, as Fuller points out so forcibly.

It is a hard task to write interestingly of the movements of armies back and forth "so many parasangs today and so many parasangs tomorrow," as old Xenophon used to move his friend Cyprus over the plains of Syria. Fuller will hold the reader better than Xenophon, and all the time will teach him something of the art of war.

C. G. Mettler.

Range Finders. By the Duke de Gramont. New York: Bretano's. Paris: Gauthier-Villars & Cie.

THIS is a concise little book on monostatic instruments and the different methods of range finding. The Duke de Gramont is an authority on these and other scientific subjects. His works on aerodynamics and applied aviation are well known.

The topical treatment of the present work includes dip range finders, stadimetric telescopes, stereoscopic and coincidence range finders. There are chapters also on the various types of range-finding instruments and their adjustment.

The book closes with a comparison between stereoscopic and coincidence range finding in which the advantages of stereoscopic instruments, especially in naval and antiaircraft fire over the coincidence method are successfully and convincingly brought out.

American Pistol Shooting, A Manual of Instruction in Modern Pistol Marksmanship. By Maj. William D. Fraser, C. A. C. New York: E. P. Dutton & Company, Inc. 1929. $5.00.

TWENTY years of hard work in developing into one of the Army's most eminent pistol shots qualifies the author of this book to write with authority. This personal experience combined with noteworthy ability in explaining the technique of pistol shooting makes this book an outstanding contribution to instruction in a difficult art. Major Fraser treats such subjects as the selection of pistols, shooting form, the aiming problem, shooting against time, shooting psychology, coaching and teamwork. In fact there is no phase of pistol shooting that has not been given adequate consideration. The book admirably fulfills its purpose of providing "a means of instruction in all forms of pistol practice in vogue in America to-day."

Stretchers, The Story of a Hospital Unit on the Western Front. By Frederick A. Pottle. New Haven: Yale University Press. 1929. $3.00.

THE man in the ranks has presented his side of the picture of warfare with great success in recent times. It is well to study this point of view, especially when it emanates from the pen of a highly educated man as is the case of the book under consideration. One might well approach a book of this title with some fear of finding overemphasis of the horrors of warfare. The description of an evacuation hospital in action in France is not precisely a story of happy adventure, but the realism is tempered with a broad sympathy with the suffering wounded as well as with the reader's natural desire to avoid the unpleasant.

Lorenzo, the Magnificent. By David Loth. New York: Brentano's. 1929. $5.00.

IF the key of an age is ever to be found in the great men who are the epitome of the desires and achievements of contemporary life, the example of Lorenzo de Medici certainly supports such a doctrine. The dominating personality of this man first in Florence, then in all Italy, embodies the very spirit of this age of the Italian Renaissance. Mr. Loth has caught this spirit and in a stirring narrative he portrays the youth and manhood of this versatile banker, poet, politician, statesman and bon vivant.

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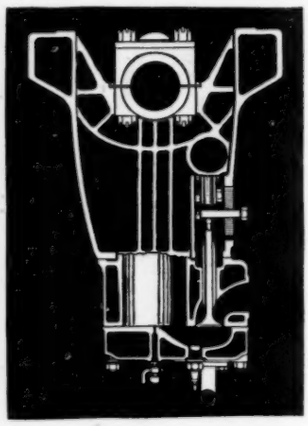

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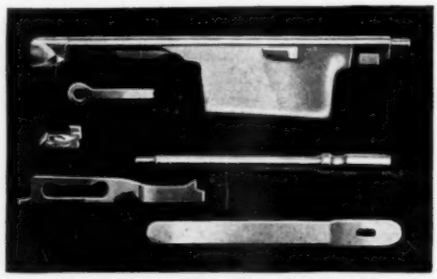

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